H. J. C. Delph. June 24th 1832

LECTURES

ON

ANATOMY.

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ANATOMY:

INTERSPERSED WITH PRACTICAL REMARKS.

VOL. I.

By B. B. COOPER, F.R.S.,

SURGEON OF GUY'S HOSPITAL, LECTURER ON ANATOMY,

&c. &c. &c.

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TO SIR ASTLEY PASTON COOPER, BART., F.R.S.,

&c. &c. &c.

PRESIDENT OF THE COLLEGE OF SURGEONS, AND

SERJEANT-SURGEON TO THE KING.

MY DEAR SIR ASTLEY,

As you were the first who pointed out to me the necessity of a work on the plan I have here adopted, and the advantages to be derived from the union of descriptive anatomy with surgical remark, I cannot refuse to myself the gratification of prefixing your name to this humble endeavour at realizing your suggestion.

The conviction with which I have been long impressed, that none but professional men can estimate professional difficulties, is another strong ground for my singling out one so eminently qualified, as you are, both to pronounce judgment and to make allowances. Whether as a teacher, an anatomist, or an operator, you have long enjoyed preeminence by the suffrages of the world; and far from seeing, in our accidental relation to each other, any cause for my withholding that tribute from you, which I should be proud to offer to the same excellence in a stranger, I do it with a deep, additional satisfaction.

I know how much, in the following pages, I have fallen short of your comprehensive conceptions; yet I am not without the hope, slender as I feel any pretension of mine, that enough of usefulness will be found embodied in them to make them not unworthy of your acceptance.

Believe me always,

My dear Sir Astley,

Your's, with unalterable attachment,

BRANSBY B. COOPER.

PREFACE.

Amidst the multitude of anatomical publications, as well here as on the continent, which the press is continually pouring forth upon the scientific world, to come before it with a volume so unpretending as this, of which both the object and matter are merely elementary, and foreign from all elaborate investigation, might seem to betray a want of judgment or a want of modesty, sufficient to discommend a far more talented endeavour than the author's.

There are circumstances, nevertheless, in which individual situation will be found sometimes to furnish both the apology and motive for such a course; and to this class of predicaments may be referred, properly, the production of the following sheets.

Every lecturer acquires a peculiar style, characteristic of his own conceptions and manner, and the best adapted, according to his ideas, for the conveyance of instruction to his pupils. But the inducement of most prevalence with the writer, to give these pages to the public, has been to obviate much inconvenient repetition during lecture, equally tiresome to the teacher and his auditory. He now leaves to his class a source of reference, conceived in the same terms and arranged in the same order as when delivered from the anatomical chair;—calculated, therefore, from that circumstance alone, vividly to impress as well as to strengthen the memory of the student.

In a work of this kind, of which the express object is utility—not fame,—he has not thought it necessary to indicate by formal reference, the many authors from whom he has obviously derived assistance: but the names of Bell, Meckell, Bichât, Beclard, Boyer—accomplished writers and practical and profound anatomists—will not, on that account, rise less readily to the reader's mind.

In conclusion, the author trusts—humble as his labours are—that they will not be found wholly unserviceable to anatomical students generally. It is not the first time that he has ventured to appear before the public on subjects of this description; and they have occupied much time spent in diligent research, and active and laborious examination.

It is his purpose, in each succeeding season, to publish an annual volume, until the series of these lectures shall be completed.

London, 1829.

CONTENTS.

LECTURE IV.

The Bones of the Extremities.

LECTURE V.

The Composition of Joints.

LECTURE VI.

Physiology of Ligament.

LECTURE VII.

Fibro-Cartilaginous Tissue.

LECTURE VIII.

General Anatomy of Articulations.

LECTURE IX.

Descriptive Anatomy of Articulations.

LECTURE X.

Articulations of the Pelvis and Lower Extremities.

LECTURE XI.

The Skeleton in General.

LECTURES ON ANATOMY.

INTRODUCTORY LECTURE.

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If the importance of a science be estimated by its utility, that which ministers to the welfare of mankind, by removing the diseases and repairing the injuries to which the human frame is liable, must be entitled to no subordinate rank. As the exercise of our profession demands a knowledge not only of the principles of that science, but of their practical application in every case that may arise, it behoves us, from a sense of honor, of interest, and of duty, to establish those principles on the most solid foundation.

In the natural order and relation of things, the study of pathology must be consequent upon that of anatomy and physiology; for it is only by an accurate knowledge of the structure of the human body, and of the functions of its different organs, in a state of health, that we can determine the nature of disease, and adopt rational and judicious rules for its treatment. To ascertain the structure of organized matter, is the proper object of anatomy; that of physiology, is to define the functions of the different organs; and that of pathology, is to distinguish the diseases or morbid affections to which they are liable. But before we proceed to consider the human body as organized matter, let us enquire into the points of affinity and of difference which it exhibits in relation to matter not organized. We find, for instance, that the human frame possesses the essential properties common to all matter, as extension, form, divisibility, inertion and attraction: hence we are led to infer, that the *animal, vegetable* and *mineral kingdoms*, are but different modifications of the same elementary matter; and that, in this respect, man must acknowledge an affinity with the tree that yields to him its fruit and its shade, and with the very rock, from which he hews the material for his habitation. Rightly considered, this reflection cannot be supposed to derogate from the dignity of human nature; for the modifications of matter in man is in many respects so different, and in all so superior, that it justly entitles him to be distinguished as the noblest of created beings. He derives this distinction from a faculty, of which the superiority appears immeasurable, even when compared with the highest of those possessed by the subordinate beings.

All bodies possessing organization and life are divided into two classes, the *animal* and the *vegetable*, and which present many points of mutual affinity. They both possess the power of producing changes within themselves; both have the faculty of generating new modifications of matter during their growth and developement: thus recruiting that waste of body which is continually going on, by the assimilation of foreign matter.

These are the phenomena that constitute the great distinction between organized and inert matter: accordingly, those objects in which this inherent vital principle is found, are designated generally as *living* matter; while those in which it does not exist, are comprehended under the term *inorganic* matter: but when living matter loses these vital functions, or, in other words, when it is deprived of the power of appropriating and assimilating foreign matter into its own substance, it retains merely the essential properties of common matter, into which it resolves itself, and in that state is capable of being effected by ordinary chemical agents. These two classes are, however, distinguished by characteristics sufficiently obvious: the animal being endowed with sensation, thought, and volition; while the vegetable is destitute of those functions.

This distinction being acknowledged, we are now to enquire on what ground man claims so high a preeminence above the other individuals of the class to which he belongs, and by what title he holds the distinction of being "the paragon of animals." The deductions of anatomy, though they demonstrate that he possesses properties peculiar to himself, do not sufficiently shew that he is not only superior to all other animals, but that in fact he takes precedence of all created beings in the visible world, and ranks next to his Creator. It is not because man is erect in stature, and has two hands, that he is entitled to a separate and highly pre-eminent rank in the animal kingdom, but because he possesses the great faculty of reason or judgment, which enables him to distinguish what is advantageous or useful, from what is inconvenient or pernicious. Self-controled, and guided by this faculty, when he feels an inclination to possess any object, he does not obey the mere impulse of such a desire, but first considers whether the act which he meditates, of appropriating that object, be right or wrong, just or unjust: thus regulating his conduct by fixed principles, and subjecting his appetites and passions to the dictates of a discriminating faculty, with which no other animal is endowed. When this faculty is fully exerted, it raises man above the sphere of self-interest, and prompts him to aim at promoting the general advantage of his species. If this, his high prerogative, be duly considered, no argument will be required to shew that man is the master-work of the Creator's hand; and that whatever is calculated to establish the health, augment the comfort, and improve the condition of a being so richly gifted and so highly favoured, cannot deserve to be otherwise regarded than as one of the most interesting objects of human enquiry. Such, for inscrutable purposes, is the constitution of the physical and moral world, that human life is not only precarious as to its duration, but exposed at every hour to a variety of ills, demanding all the resources of human knowledge for their prevention or cure.

Health is universally felt to be the greatest of all earthly blessings; it is, in every condition and degree of society, the sweetener of existence; with it, the poor, through industry, attain to independence, to affluence; with it, the wealthy relish the advantages of riches; without it, the peasant must struggle against penury, and die a lingering and a cheerless death; while the rich, even the monarch himself, if denied so precious a boon, must feel all the refinements, the splendour, the luxury that opulence can purchase, to be merely a splendid curse; must regard even the most intellectual of all social pleasures with a weary eye; "view, undelighted, all delight," and denounce the amenities of life. If such be the value of health, never so truly estimated as by its loss, how important a share of attention must be claimed for that science which aims at its preservation!

In this introductory address, it will be my endeavour to explain the object and bearing of this course of lectures, and to point out the best mode of acquiring a knowledge of the structure and uses of the various parts of the human body—which branch of science is designated human anatomy.

Although to acquire a knowledge of pathology and therapeutics be the ultimate object of the medical student, still it will be obvious to every one of you that these studies must be preceded by, and founded upon a perfect knowledge of the anatomy and physiology of the human body; for it is only through these that we can determine the nature and extent of disease, and by which we can hope to adopt rational and judicious rules for its treatment. Since to ascertain the structure of organized matter is the proper object of anatomy, and to define the functions of the different organs, that of physiology; so, to distinguish the diseases and morbid affections to which they are liable (as well as to remove them), is the object of pathology and therapeutics.

Having already necessarily made use of different scientific terms, I conceive it a duty imposed upon me, before I proceed further, to give you a concise explanation of them; for without their being rightly comprehended, I could not be understood.

First, of *anatomy*, which, etymologically considered, merely implies the means employed for anatomical investigation, and not the science itself. Some modern teachers have attempted to explain its meaning by terming it the science of organization; but this also seems to me vague and indefinite, as it does not comprehend in what manner it treats of organized matter: I believe, therefore, the term will be more readily understood, by considering that anatomy is that science, which has for its object the investigation of the structure and configuration of organized bodies. As geometry treats of the forms of unorganized substances, so does anatomy treat on organized bodies; and indeed the parallel may be found even in the language of the two sciences; for as geometry proceeds from points, lines, and surfaces of mere magnitudes, so does anatomy found its propositions, by assuming existence of certain fundamental tissues or parts, distinguished by the terms fibre, globules, and laminæ, as the elements of organized matter.

By an organized substance we mean an object in which all its constituent parts, organs and systems, are mutually means and ends to each other; each contributing to the support and duration of the whole, and each, therefore, being maintained by the coexistence of all the rest.

To convey a knowledge of the structure and texture of the human body, is the principal object of the science of anatomy; for as its mere name implies, and, in contradistinction to physiology, it may be said to consider the human subject as a mere organized structure; while, on the other hand, physiology recognizes man not only as an organized, but at the same time as a living being (organismus): nor does it stop here; for the science of psycology leads us still further, and treats of man as an organized, living and intellectual being. Again, the science of anatomy of the human subject may be distinguished into general, special and comparative.

General anatomy considers only the general form and denomination of the minute parts, and the variety of those organs, which, taken collectively, constitute the entire organismus, describing their general structure, texture and arrangement.

Special anatomy, on the other hand, enters not only into a minute examination of the structure and texture of all the component organs, but considers in detail the different constituents of each part, of even one and the same organ.

The object of *comparative anatomy* is to compare the construction of one organ in the human subject, with those of the lower animals.

The *pathological*, or morbid anatomy of the human subject, cannot be treated separately, but should rather be connected with *both* general and special anatomy.

However, since what is called the vital or living principle, its developement and modifications, as also its diseases, exercise great influence upon the structure and texture of the various systems and organs of the human body, it is obvious that some general physiological and pathological observations must necessarily be added to the lectures on anatomy.

But before I proceed in this lecture to the consideration of the general anatomy of the human body, it will be better first to premise an explanation of the various technical terms which are made use of in designating the different parts of the whole body, and which are as follow: tissues, systems, organs, functions, and organismus. These I shall separately describe.

First.—*Tissue*, which is intended to signify a certain arrangement in the elementary particles, of any portion of an organized substance, so as to give it a peculiar texture. And hence, all those parts of an organized body in which the same arrangement is found, are said to belong to the same tissue: as, for instance, the osseous, cellular, &c. &c.: the one being easily distinguished from the other.

Second.—A *system* means an assemblage of parts, which, although various in their individual arrangement, are still identical in their texture, and in most systems, are each in direct continuity.

Third.—*Organs* are the assemblages of parts, which, although various both in their structure and tissue, nevertheless cooperate to effect some particular purpose; as all the different parts of the liver cooperate in the formation of the bile.

Fourth.—*Function* consists of the action of several different organs, acting in unison for the completion of one end, necessary to vital existence; as digestion, &c., is effected in the conjoint operation of the stomach, bowels, liver, and pancreas.

Fifth.—*Organismus* is a term used to express the assemblage (as before mentioned) of all the organs of the human body, performing their individual and natural functions for the perfection and preservation of the whole.

Now, in treating of any organized body, and more especially that of the human body, we must first consider its structure and texture.

The human body, in common with all organized bodies, presents a rounded form throughout, never presenting either an angle in its parts or its whole. With respect to its division, it may first be considered as divided by an imaginary vertical line, which separates it into two symmetrical sides, and like the bodies of all other vertebrated animals, is divided into head, trunk, and extremities. The trunk forms its central part. We further observe in the whole frame, three principal cavities, which enclose the organs called *viscera*, and which are absolutely essential to life. The head forms the superior cavity, is lengthened through the vertebral column, and encloses in its whole extent the brain and spinal marrow, the centres of the nervous system and the senses.

The middle cavity is the thorax, and is for the purpose of containing the organs of respiration and circulation. The lower cavity, the abdomen, lodges the organs of digestion, of the urinary secretion, and of generation.

The extremities represent articulated appendices, and are distinguished by the denomination of superior or thoracic, and inferior or abdominal members. All these great divisions of the body consist of many subdivisions, a full description of which belongs to special anatomy; but as a general remark it may be observed, that both the principal divisions and the subdivisions of the whole, are determined by the extent and position of one or more of the bones constituting the skeleton.

The human body, like that of all other organized bodies, is composed of liquids and solids, which are continually changing into one another. The fluids form much the greater proportion in regard to bulk ; it should however be observed, that their exact proportion to each other cannot well be ascertained, as some of the fluids are with great difficulty separated from the solids.

Some anatomists have, indeed, assumed the proportion between the liquids and solids to be as six to one ; and others, even as nine to one : but their proportion varies according to the individual, sex, age, and constitution.

Having investigated and described the various parts that compose the human body, the formation of which, from their instrumentality, are denominated the organs, I shall now proceed to explain their uses and functions, thus developing that branch of the science which is termed physiology. The consideration of the structure and functions of the organs in their healthy state, will be naturally followed by that of the changes produced in them by disease or injury ; and thus the department which is termed pathology, will be elucidated.

To enumerate in detail the several parts of the human body, would on the present occasion be superfluous ; I shall, therefore, confine myself to such a general view of them, as may lead you to consider, how beautifully the machine is adapted to the purposes for which it is destined. The body, as has already been observed, consists of a duly proportioned aggregate of solids and fluids, subject to constant waste, which is repaired by the introsusception of certain extraneous substances, collectively termed food. Man is enabled to obtain the fresh supply requisite for his subsistence, by the aid of the senses, sight, hearing, smell, taste, and feeling ; four of which are exercised by particular organs, while the nerves, ministering to that of feeling, are distributed over the entire surface of the body. As the objects of his wants may be more or less distant, it is requisite that man, in order to attain them, should possess the power of locomotion, and a form suited to the exercise of that power. A secure basis being absolutely essential to his support, the whole structure is firmly secured by a substance termed BONE; which, like a frame-work, gives support and protection to the surrounding soft parts, and maintains his proper stature. That they may not add too much to the weight of the body, the bones are formed hollow, and are thus rendered much lighter than they would be if solid, yet without suffering any diminution of their strength. The bones being the basis of locomotion, and, as such, being required to permit the most rapid and varied movements of the body, would utterly fail to answer that purpose if they formed one continuous mass; wherefore, like a complex and ingenious piece of mechanism, they are found divided into a great number of parts, so disposed as to play easily, and adapt themselves readily to every act of the body, and to every change of attitude and posture. At their extremities we find a substance, admirably adapted by its smoothness and elasticity, to prevent concussion and friction; this substance is called *cartilage*. In those joints which are entirely subject to the influence of the will, this substance is found merely tipping the ends of the bones; but in parts where motion is considerably restricted, we find cartilages firmly uniting bone to bone: as, for instance, the ribs to the sternum. Not only are the extremities of bones protected by this substance, but friction between them is still farther prevented by a fluid termed *synovia*, which is poured from the extremities of arteries terminating by open mouths in the internal surface of a synovial membrane, which prevents the escape of the fluid. This apparatus is always found at articulating surfaces; and the quantity of synovia supplied is always proportioned to the extent of motion in the joint, and to the consequent danger of displacement. Another structure forming part of every articulation is *ligament;* so called, from its function of connecting bones together. Ligaments are strong inelastic membranes, uniting the extremities of moveable bones in such a manner as not to interfere with motion, except where it has a tendency to be carried beyond its natural extent, which the ligaments restrain, and will not permit without rupture. Thus by bones, the organs of support: by ligaments, the organs of connection: and by the substances interposed for protecting and lubricating the articulatory surfaces, the fabric of the body is rendered capable of being moved. I shall now proceed to consider the manner in which the movements of the body are effected. The instruments or organs by which corporeal motion is performed, are the muscles.

The term *muscle,* is derived by etymologists from the Greek word ὁ μυων, that which contracts or closes, (from μυω, claudo) and aptly designates a property peculiar to this organ. Muscles are formed of long parallel fibres, connected by cellular membrane, and, in the human body, are generally of a red colour. Soft, irritable and contractile, they are well adapted for producing the great movements that take place in the living body. On tracing a muscle, we find it originating from a considerable extent of surface, gradually converging to a small space, to be united to a chord called a *tendon.* This tendinous structure, consists of fibres of a white colour, firmly united together, and extending in a uniform direction to the muscle, to which the tendon is attached. By the contraction of muscles, motion is produced, as must have been experienced by all who are conscious of this faculty, though from usage not attentive to the manner of its exercise: for instance, the *brachialis internus* is one of the muscles intended to raise the fore arm; by the contraction of this muscle, the bone into which it is inserted,—that is, the coronoid process of the ulna,—is brought nearer to the *os humeri,* from which it arises; and in this way the elbow joint is bended. The joints are provided with as many muscles as are necessary for the possible flexures of those joints in the different motions of the body, each muscle moving in a proper direction on the bone to which it is attached. The extent of power in a muscle, is proportioned to its magnitude, or to the number of fasciculi composing it: hence arise the different degrees of force, or power, that are found to be exerted in leaping, running, rowing, throwing the discus, and other corporeal exercises. When you have attentively considered, how the different parts composing the fabric of the human body are capable of being separately or simultaneously moved by the appropriate organs assigned to them, and how the muscles produce the complicated and infinitely varied motions of the machine, you will be fully prepared to examine the physiology of locomotion. In walking, for instance, the first act required is, to fix one part of the body, so that the other, released from its office of contributing support, may be free to perform muscular exertion at the dictate of the will. Thus while one leg sustains the whole weight of the body, the muscles of the other are brought into action ; the limb is raised and extended ; the body is brought forward by the muscles of the fixed side, and its weight is transferred to the advanced limb, which in its turn becomes fixed, and sets the other at liberty to advance.

In adverting to locomotion, I have already supposed that the great purposes of this faculty, are to enable the animal to approach those objects which may serve as aliment, and to shun those from which it may apprehend danger, molestation, or annoyance. Here we perceive a great distinction between the two great classes of organized bodies, the animal being capable of changing its situation, while the vegetable is necessitated to remain stationary. By the locomotive faculty, man is enabled to procure all the substances capable of being converted into nutriment, by the action of the digestive organs. Of such substances, there is an almost infinite variety; man being, in the phraseology of the naturalist, an *omnivorous* feeder. The food is conveyed by the hand to the mouth, which is opened for its reception ; it is then masticated by the co-operation of the upper and lower jaw, formed into a bolus by the tongue, lubricated by a fluid of the mouth, and thus rendered fit to be swallowed, as well as to undergo certain changes in the stomach. The food thus masticated and prepared, is passed by the action of the tongue upon the soft palate, into the cavity of the fauces, towards the pharynx. Stimulated by the presence of food, the pharynx contracts and presses it into the canal of the œsophagus, the muscular fibres of which by their action convey it into the stomach.

From the organs necessary to the processes of deglutition, I pass to the digestive organs, commencing with the stomach: a membraneous bag, which is situated in the cavity of the abdomen, and which constitutes another important distinction between the animal and the vegetable kingdom; animals receiving their nutriment into an interior organ for assimilation, while plants imbibe theirs at the surface. The stomach is found in every animal, and may be considered as constituting the organic difference between the animal and the vegetable world. The process by which food is converted into nourishment, and which constitutes the peculiar office of this organ, is termed digestion. By the action of a powerful solvent called the gastric juice, supplied from the glands of the stomach, the food is converted into a pulpy substance called *chyme*, and it then passes through the pylorus into the duodenum, where it mixes with other fluids, the bile, the pancreatic and the enteric juices, and is converted from chyme into *chyle*. The whole of the substance however is not transmuted into chyle, for a considerable portion of it passes away as useless and feculent matter. That portion of it which is proper for corporeal sustenance, is taken up by the absorbent vessels from the small intestines, which are furnished with a number of folds of a valvular structure, called *valvulæ conniventes*, which tend to retard the passage of the feculent matter, and by enlarging the surface enable the lacteals to take up such portion as may still prove nutritious.

This rather minute detail of the alimentary process, appeared to me requisite, for the purpose of showing how the continual waste, or wear and tear of the body, is supplied and repaired, by the assimilation of the various substances collectively termed food. We are now to trace the nutritive part of this aliment from the stomach and intestines, into the vital system, or, as it is commonly called, the circulation. The nutriment having been taken by the lacteals from the intestines, passes through a membrane called the *mesentery*, and in this state, if examined shortly after an animal has taken food, it is found to consist of a white opaque fluid resembling milk. It passes from the mesentery to a large canal called the *thoracic duct*, which, originating from the loins, extends along the spinal column, and through the chest, terminating at the junction of the internal jugular, with the subclavian vein. The direction of the fluid in its passage to the thoracic duct is uniform, there being a certain valvular apparatus, which presents an insuperable resistance to any retrograde movement. It is thus conveyed into the blood to be circulated with it, and to contribute to the support, accretion, and reproduction of every part of the body. We find, therefore, that the constituent parts of animal bodies, though so different in many particulars, are all formed from one common element, into which they are capable of being resolved; nor can this homogeneity excite surprise, when we consider that it is from the blood that every structure in the body, from the firmest to the most limpid, must derive its supplies.

The blood itself, however, is composed of several distinct constituents, as may be demonstrated from the separation which takes place in any portion which has been drawn from the living body.

To the circulation of the blood, we cannot advert without being reminded of the great and immortal name of Harvey, who, in 1628, first comprehended and demonstrated that important function which had baffled the philosophic inquiries of his predecessors, ancient and modern, constantly stimulated as they must have been, by a phenomena so remarkable valves, during the action of the ventricle, to be prevented from acting upon the auricle during their contractions. Hence it is clear, that the two auricles and the two ventricles must operate in unison,—their action must be synchronous. By the propulsive force of the ventricles, such an impetus is given to the blood as to produce distension and momentary vileration in the arteries—a phenomenon which is commonly and aptly termed pulsation; but in the veins the blood flows in an even and equable current—the momentum originating in the heart being expended ere it can reach them.

Thus the circulation may be regarded as including two consentaneous and co-operative systems—the venous and the arterial; the one serving to build and repair the body, while the other supplies the materials. It may be proper to inquire into the means by which the various and very different parts which constitute the human frame, are all produced from one homogeneous fluid. This wonderful result will be traced to the extremities of the arteries, where it is effected by what are called the functions of exhalation and secretion. The fluids are produced by exhalation, where arteries terminate upon any surface by open mouths, under an arrangement so peculiar, as to allow the separation of certain of the constituent parts, without the intervention of any organ, the separation taking place from the vessels themselves. On the other hand, the secreted fluids are produced by a mechanism much more complicated, which effects in them an infinitely greater difference from the blood itself. For instance, if we examine the bile or the saliva, we discover in either of those fluids very different properties from those possessed by the blood; while the fluids produced by exhalation bear a strong resemblance to that which blood would become, if deprived of its red particles. To elaborate the change in one case, a substance called a gland is provided, into which arteries ramify, and in which, originate a new set of vessels, termed excretory ducts, for the conveyance of the fluid to some organ in subservience to a peculiar function; in the other case, the exhaled fluid is usually returned into the circulation by the process of absorption. Thus it would appear, that the great difference between the two processes is, that the one is very simple and the other extremely complicated. Thus the abundant supplies, furnished to every part of the body, are derived from the ramifications of the arteries through two distinct processes.

We find that exhalant vessels are constantly pouring out fluids; as, for instance, those within the cavity of the peritoneum, and those which supply synovia for lubricating the joints. This latter fluid would be constantly accumulating within the cavity of the articulations, were it not for another operation which is in constant progress; its tendency being to maintain an exact proportion between the fluid secreted and the fluid removed, and thus to prevent distension in the secreting cavities of the body. If we inquire into the origin of this the *absorbent* system, and into the purposes for which it is adapted, we shall find that the absorbents, while they act as the constructors of the body, reject what is superfluous or would be injurious, and take up that which is proper for its nutriment or advantage. Like the arteries, these vessels are found diverging into ramifications, arising from all the mucous and serous membranes, and also from the cellular membrane. They anastomose also like arteries, and form large trunks, which do not pass at once into the thoracic duct, but subdivide and enter into an interjacent apparatus, called absorbent glands. The vessels into which they thus subdivide are called *vasa inferentia;* and those which pass out from the same gland are denominated *vasa efferentia:* the former have the superiority in number, the latter in capacity. On examining the structure of these vessels, we find their *parietes* thin and diaphanous, composed of two coats; the inner coat forming folds, which are termed *valves,* and which resist any retrograde motion to a degree exceeding the apparent firmness of their substance. They have the power of taking up the fluids that come in contact with their orifices, and of conveying them into the circulating blood; this function, termed absorption or inhalation, must exist wherever such vessels occur. It is also to be remarked that the absorbents are adapted for the removal of the solids, which, however, must have previously undergone solution.

It is an ordinance of nature, that animals should have the power of propagating their own species; and they are accordingly provided with generative organs, in the respective formation of which consists the distinction of the sexes. Those organs, in either sex, are divided into external and internal: the external may be considered as destined for the purpose of procreation; the internal, in the male subject, include the apparatus requisite for producing impregnation, while those of the female are adapted for conception and gestation.

Our attention must now be directed to the cellular membrane,—a soft, spongy tissue, extending through all the divisions of the body, surrounding all the organs, forming at once their medium of union and separation, penetrating into their substance to pervade in like manner their component parts, thus entering into the organic structure of all organized bodies, and constituting the principal element of organization. This substance may be regarded as consisting of true cellular membrane, and of adipose membrane; the former being universally diffused, while the latter is excluded from the eyelids, the scrotum, and every other part where the presence of fat would interrupt or impede an essential function. The whole exterior surface of the body we find to be covered with a strong elastic integument, called the skin: it is divided into two layers, of which the internal is called the true skin, and the external is termed the scarf skin, or epidermis. Anatomists have distinguished a third layer, which, from the characteristic colour, is quite apparent in negroes; and this they denominate the *rete mucosum*. It is the property of the skin, not only to afford protection to the organs beneath it, but to exercise functions peculiar to itself; namely, the exhalation of a gas, and the exsudation of perspirable matter, and of sebaceous secretions, while it permits the excrescence of the hair.

In this general view of the human frame, you may have observed that its component parts, which have hitherto engaged our notice, are divisible into two classes—the *mechanical* and the *vital* organs. Of the former class, the bones may be considered the organs of support, the ligaments those of connexion, and the muscles those of motion; while the organs of the latter class respectively perform the functions of assimilation, circulation, exhalation, and secretion. In proceeding to consider the intellectual organs, which may be regarded as forming a third class, we are to observe, that the wonderful structure which we have been contemplating would remain inert and passive, were there not a medium of communication between the faculties, comprehensively termed MIND, and the organs subjected to that act of the mind, denominated VOLITION, or WILL. That this mental sovereignty may be exercised, that the presiding intellect may be informed, and that its decrees may be executed by the subordinate agencies, man is furnished with a nervous system, consisting of brain, spinal marrow, and nerves, which, being acted upon by various sensations, produce impressions on the mind in its supposed residence or sensorium, the brain. I say its *supposed* residence; because, in tracing the connexion of matter with mind, we lose the clue of demonstration, and have only strong inference or conjecture for our guide; that connexion, like vitality itself, is a mystery which human reason cannot unveil. The brain is situated in the head, in direct proximity, be it remembered, with the "local habitation" of four of the five senses: the spinal marrow is placed in the vertebral column, and the nerves are distributed through every part of the body. These three grand divisions of the nervous system are more or less connected with each other, and are reciprocally subservient. The impressions of which the brain is susceptible have been distributed into five classes, corresponding with the five senses: but it would be more correct to say, that each of these senses communicates its peculiar class of impressions. The sense of touch, for instance, conveys to us the notions of roughness, smoothness, hardness, softness, and many other qualities; and the same observation may apply, in a greater or less degree, to the rest of the senses. Without going into detail respecting them, we may observe, that these sensations are conveyed through the respective nerves to the sensorium, the brain. But this organ is endowed with other faculties, which cannot now require to be enumerated: our present purpose is to particularize *volition*, by which it operates instantaneously through the different nerves, on such parts or organs of the body as are subject to the influence or control of this faculty. We may add, that it operates simultaneously on parts which are distinct and remote from each other; as when a lady *sings* from *written* music, and *plays* an accompaniment on the harp. The grand distinction between sensation and volition appears to be this:—sensation commences at the extremity of the nerves, and passes to the brain; while volition originates in the brain, and passes through the nerves to the limbs and other parts of the body that are susceptible of voluntary action, and are naturally actuated according to the purpose which the mind has willed to achieve. I would not here be understood to trench on the province of the moral philosopher, but to consider these phenomena in a strictly physiological point of view; I speak, therefore, of volition as a faculty participated by other animals in common with man. The sensation of hunger urges the lion to prowl for prey: the same sensation impels the savage of the woods, the mere animal man, to dig the earth for roots, or to slay the beasts of the field. The difference between man and the noblest of the inferior tribes of animals, consist, as I have already observed, in that reason, which, ever progressive, develops new resources for supplying his wants; and, as civilization advances, brings into clearer light those immutable principles of equity, which, tempered by the social virtues, constitute that bond of union among all families, communities and nations of the earth, universally recognized, in its most extended and exalted sense, by the honourable name of *humanity*.

Having noticed the two great qualifications of sensation and of will, as peculiar to the nervous system in general, I may now observe, that the nerves are subjected to another kind of action, which in no degree obeys the control of the will, and which influences the involuntary functions of life. This influence operates through the agency of the sympathetic nerve; so called because it supplies, in common, those organs of which the constant action is essential to existence. This nerve is connected with the brain, as well as with the spinal marrow; and from their union may be solved the problem, why mental impressions are capable of affecting the involuntary and merely mechanical action of certain organs. Thus we may account for the acceleration in the beating of the heart, and in the peristaltic motions of the intestines, when the mind is actuated by fear or any other strong emotion. Not only does the brain serve as the principal abode of those qualities which are capable of sustaining the indispensable functions of organic life, but it is the council-hall—the consistory, in which the intellectual functions are exercised, and all mental operations performed. In the brain reside intellectual conception, the offspring of sensorial impression: memory, including the power not only of remembering, but of recollecting at will, events or facts which have once been known: imagination; or, the power of forming new combination: and judgement; or, the faculty of comparing and distinguishing right from wrong, truth from falsehood, equity from injustice:—all these faculties, when cultivated and improved by proper exercise, serve to qualify and accomplish man as a social being; and to elevate him to that station, which his Creator intended him to attain; as the sovereign lord of that earth, which he was authorized to replenish and to subdue.

In concluding this outline of the course of study upon which you are about to enter, I would intreat your farther attention, Gentlemen, to some observations on the subject of those duties which you owe to yourselves, to your parents, and, I may add, to the community at large; for upon the faithful and zealous fulfilment of them, depends the question whether you are to be the most useful or the most dangerous members of society. I feel, therefore, as surgeon of this hospital, and your teacher of anatomy, that I ought, in terms of no ordinary earnestness, to impress on your minds the necessity of a diligent and judicious application of your time during your stay at this school. The interest I take in your welfare, the anxiety I feel for your advancement to eminence, the satisfaction I shall ever derive from the reflection of having contributed to it, and the hope (not I trust a misplaced or visionary hope) which I cherish that my wishes will be realized, call loudly on me to intreat your assistance in the undertaking. It were a superfluous office to remind you, that it is not on me, but on yourselves principally, that your future success depends. The science of anatomy is easily attained, when the determination to attain it is sincere; in this pursuit, no difficulties will arise which attentive assiduity may not surmount; and no barrier will be opposed to your ultimate success, which idleness has not erected. Among the votaries of this science, as of others, there are many who profess to disclose a shorter path to excellence than that of industry; in this, as in other studies, many expedients have beeen devised by which the toil of research and deduction may be saved; but let no man be lulled into indolence by specious promises:—excellence is never granted to man but as the reward of labour. It evinces indeed no small strength of mind, to persevere in habits of industry, uncheered by the animating pleasure of perceiving the advancement made; which, like that of the hand of the clock, which uneringly accomplishes its circles of the hour, yet so gradually as to escape observation. Remember, that anatomy is the basis of surgery; and that if the basis be not solid, the superstructure cannot be secure: there scarcely exists a case in surgery in which the knowledge of anatomy is not required: and I have little hesitation in asserting, that when professional disgrace has fallen upon any members of our profession, it is very rarely that the causes of that disgrace, may not have been ascribable to ignorance of this essential department; as essential, indeed, as mathematical science to the navigator. Should you, as most of you probably may in the course of your practice, be summoned to give evidence in a court of justice, when the learned judges on the bench look to you for the illustration of the case before them, and the life or death of the accused rests solely on the evidence which you may present,—consider what an awful responsibility is vested in you. The council retained, take care to supply themselves with all the anatomical knowledge which the case may require, and your professional reputation may be materially affected by your replies.

Medical men are perhaps more liable to be depreciated in public estimation by forensic evidence, than by any other contingency. Questions are put by counsel, which require a most minute knowledge of anatomy and pathology, to answer satisfactorily; and the hesitation which must inevitably accompany an imperfect knowledge of those sciences, must produce a most unfavourable impression on all present; an impression detrimental to the future prospects of the witness. Agitation, embarrassment, constitutional timidity, can scarcely be alleged in extenuation on behalf of the member of a profession, in which presence of mind is an essential requisite; and even the diffidence that so often attends real talents and acquirements, will be but too often illiberally misrepresented.

That the path to eminence is rugged, and the ascent steep, I freely admit; if such difficulties did not intervene, there would be little merit in attaining the summit; yet the way is open; the path, though rugged, is clearly to be traced; and as to what may depend on confidence in the guide who is to conduct you, I pledge myself that you shall not be deceived. Though I stand here as your instructor, it were my prouder boast to be regarded as your fellow-labourer. I would wish you to look on me only as one who has toiled through the journey, and is about to recommence it with you, only that he may facilitate your progress. Whenever, therefore, you may do me the honour, Gentlemen, of soliciting my assistance, rest assured that I will afford it to the utmost of my ability; and if I can contribute by any exertion of mine to your instruction and advancement, I shall feel a happiness commensurate with the benefit which you may derive. I hope that I am addressing those who are as anxious and as determined to become useful members of society, as I am to assist them by all the means in my power, for the attainment of that laudable end. You have selected and embarked in a noble, an honourable, and a useful profession; and you feel determined, I doubt not, to uphold its respectability. Remember, that you are about to be surrounded by a multitude of temptations, of which you must bear to be told, that they are dangerous in proportion to the difficulty of resisting them; and which it will require no ordinary share of fortitude, combined with a manly and salutary sense of their danger, victoriously to withstand. There are among you those who, gifted with talents and education, enjoy also the advantages of property, of address, of personal appearance; these qualities, however, if they be not converted into ministers of your welfare, your best friends, will prove your greatest enemies. If the money which your relations have devoted to the purpose of your education, or generously bestowed on you for your personal comfort, be dissipated in folly or lavished in extravagance, while your time is consumed in idleness, you will return home, tortured with that remorse of conscience which is the bitter and inevitable consequence of such conduct; and, instead of being received with affection, you will be met with frowns—the just token of displeasure from those to whom you were dear—whose liberality has been abused, and whose hopes have been defeated. There may be some among you who have to depend solely on their own industry; who look alone to their own exertions for subsistence, and who must ultimately beg or starve, if they neglect their duty: "that merit rarely attains to eminence, when restrained by want," is a lamentable truth; but it may be no small consolation for those who may have to struggle with adversity, to be reminded, that some of those whom our profession is proud to acknowledge as her brightest ornaments, have worked their way from poverty to affluence—from obscurity to imperishable renown. It is not your daily attendance on lectures, or your regular appearance in the dissecting-room, in compliance with the customary routine of study, that will at all avail, unless your attention be exclusively devoted to the subject before you. In this perhaps more than in any other pursuit, the Roman maxim should be emphatically enforced: that which deserves to be done at all, should be done in the best possible manner; or, in briefer phrase, whatever you do let it be done effectually; done with heart and soul. Let not your time be absorbed, and your attention altogether distracted, by taking notes of these lectures; as that which is mechanically and literally committed to paper, is too often lost to the memory. When you go home from lecture, deliberately and carefully recall to mind that which you have heard; it is the notes taken after lecture that will most redound to your advantage; what is then written will be easily recollected, while dissection will rivet it in your memory, and accomplish you as anatomists.

A few words, Gentlemen, on your conduct when you shall have embarked in the practice of your profession, and I will trespass on your time and patience no longer. Be not misled by the delusive notion that in acquiring a proficiency as anatomists, and even in qualifying yourselves to become eminent as surgeons, you will have ensured professional advancement; the general line of conduct, the kindness and attention to patients, the pains taken, in short, to render yourselves worthy to be beloved as men, while you are esteemed and respected as surgeons, will materially influence your success. You will have to prepare for numerous difficulties, many of them unforeseen and to be promptly encountered; but he who cannot strain against, and stem the adverse tide, should not launch forth into the troubled sea of life. Remember, that in proportion as you become objects of envy to your competitors, you will become objects of detraction. When you have to confer with scientific men, treat them with the respect they merit; when you meet with ignorant practitioners, bear with them. Do your duty to your patient, but never for a moment imagine, that the ruin of another's professional character can advance you a single step in the path to eminence.

That calm presence of mind which directs the hand, will be found most favourable to the exercise of the judgement in your general conduct; and as I entertain no doubt that you are determined to be good surgeons, so I am confident that you will ever cultivate those gentlemanly feelings which should characterize and adorn your destined rank in society.

These suggestions, Gentlemen, you will consider, not as authoritative precepts, but as appeals to your good sense; and accept them, with my best thanks, for your attention. I need not again remind you of the value of that time, even in its minutest portions, which is devoted to scientific pursuits; satisfied that your youthful and ingenuous ardour will inspire you with that unity of purpose, which is the best earnest of success, the surest prognostic of an honourable and splendid career.

LECTURES ON ANATOMY.

PART I.

THE OSSEOUS SYSTEM.

LECTURE I.

PHYSIOLOGY OF THE BONES.

The osseous system consists of those hardest parts of the human body, which, when arranged in their proper order, and connected by their natural ligaments, are well calculated to support the soft parts attached to them; and, indeed, to constitute a framework by which the machine may be managed when in active motion, and sustained when quiescent.

All the bones, excepting the teeth, are more or less deeply seated; each being surrounded by soft parts, and presenting no exterior surface. They are covered by the muscles and integuments, which adapt them for the support of the arterial and nervous systems, and for the due formation of joints.

The number of bones is considerable; amounting, at the adult period of life, to two hundred and forty-one; but they vary according to age. Many of the bones which are single when ossification is completed, during infancy are separable into many parts.

The size of the different bones varies considerably: some of them are found to measure nearly a fourth of the whole length of the body, while others are but a small portion of an inch in extent; and from this difference in their size some anatomists have classed them.

Bones are also divided into portions as regards their individual extent: thus the bones that exist singly are said to consist of a body or centre, and of two sides, joined by an imaginary middle line, which divides them into symmetrical halves. Again, some bones are distinguished into parts according to the uses which those parts serve: thus the os frontis is divided into the orbital and nasal processes.

Form of the Bones.

With regard to the geometrical figure of bones, they are divided into three classes, The *long bones* are those in which the dimensions of length considerably exceed those of breadth and thickness: others, in which the length and breadth are nearly in equal proportions, are termed the *flat or broad bones:* whilst those whose length, breadth and thickness are nearly equal, are distinguished as the *short bones.* There is, however, a fourth class, in which no one of these dimensions sufficiently prevails to entitle them to any class in the above arrangement. These are termed the *mixed bones.*

Bones of the first class are situated in parts of the body where extensive motion is required—the limbs are composed of such bones. The second class, or the flat bones, have nearly all of them concave and convex surfaces, destined to protect important organs, for which their curved form admirably adapts them, by giving them a power to resist external violence. The third class is found in parts of the body where rapidity of motion is required, combined with great strength: such bones, therefore, are found composing the carpus, tarsus and spine.

The single bones of the skeleton are symmetrical in their form, and have their sides uniform; while those bones that exist in pairs are invariably alike. The short bones have not any great uniformity in their external configuration, as they are modified according to the general purpose of that assemblage of bones, of which they individually form a part: thus we find the different uses of the carpus, metacarpus, and spine, determine also the variety in the external form of the small bones that compose them.

All the bones present on their external surface irregularities, which may be termed eminences, and these again are denominated either epiphyses or apophyses: the former are bony parts of a secondary formation, and will therefore be more particularly described when speaking of the developement of bones; while the latter, or apophyses, are processes of the original bone. These apophyses offer considerable varieties, both as to their use and configuration. They may, however, be divided into three grand divisions:—First, apophyses of articulation; secondly, of insertion; and thirdly, of reflexion.

Those of the first division, or the apophyses of articulation, differ according to the form and motions of the joint of which they are destined to form a part, and will be more particularly described when speaking of the joints in general.

The second division, the apophyses of insertion, are very numerous in most of the bones: they are for the purpose of giving attachment to muscles through the medium of their tendons; they also afford attachment to ligaments and aponeuroses. These apophyses are much less developed in the female, than in the male; in the weak, than in the robust. Moreover, whether the apophyses be projecting portions of bone to receive a tendinous attachment of muscle, whether it be in the form of an extended *line* for the aponeurotic attachment, or whether it be the *asperity* for the direct attachment of muscular fibre, we uniformly find the developement of each of these kinds of apophyses proportionate to the energy of their respective muscles. The varieties in the external configuration of the long bones, produced by the degree of developement of these apophyses, are often very considerable, but without any corresponding deviation from the regular cylindrical form of their interior. The apophyses for ligamentous attachment are intended to remove, in some measure, the ligaments from the surface of those bones of which they are the uniting substance in the formation of a joint.

Those of the third division, the apophyses of reflexion, are such, as under which a tendon passes in deviating from its primitive course: they are generally excavated; and, by the assistance of a ligament, formed into complete rings for the passage of tendons.

Depressions of Bone.

Bones have likewise depressions or cavities, which are distinguished into articular and non-articular: the latter are found to be either confined to the external surface of the bone only, or to extend deeply into its substance. In the former instance the bone is particularly adapted for the attachment of muscle, as by such depressions it presents a larger surface; whilst in the latter case, they serve for the formation of cavities. Of the non-articular depressions it is now my purpose to treat, leaving the articular depressions, with their corresponding eminences, to be described when speaking of articulations.

The non-articular depressions are divided into those on the exterior, and those within the bones. Those external to bone, are divided into three kinds:—First, those of insertion; secondly, of reception; and thirdly, of facilitating motion. Those of the first kind give attachment either to the aponeurotic insertion or origin of muscles; and, from the concavity, offer the advantage of enlarging the surface of the bone, and thereby of multiplying the points of attachment of the muscle without increasing the bone itself. The pterygoid and digastric fossæ are examples of this class.

Secondly, the cavities of reception, are those which serve to receive an organ, to lodge and protect it; and these are principally found upon the flat bones, as on the bones of the skull and pelvis. These cavities sometimes form the whole of one surface of the bone, and at others are insulated depressions. The venter of the ilium is an example of the first, while the depression on the outer side of the orbit, for the lacrymal gland, illustrates the latter variety.

Thirdly, the cavities for facilitating motion, are generally found at the extremities of the long bones: they are fissures, more or less deep, in which the tendons glide to pass to their insertions. They are lined with cartilage, and formed into complete foramina by ligaments which tie down the tendons in their passage through the grooves.

There are also enclosed cavities in bones, which produce in the long bones cylindrical canals, forming the medullary cavities, occupying the middle of the bone, and terminating at its extremities in the areola of the spongy substance. These cavities tend to render the bone lighter in proportion to its bulk, and stronger in proportion to its weight. In infancy, while the extremities of the bones are cartilaginous, the medullary canal is shorter in proportion than in the adult; and, indeed, is not completed until the epiphyses are perfectly ossified. Even in the first formation of callosity, after the fracture of a bone, this canal is obliterated by being filled up with cartilage, and is not re-established until this cartilage is completely converted into bone. There are no bones in the human body that have their medullary canal extending through their whole length. There are also canals found running into bones for the transmission of blood-vessels, as well to the medullary system as to the bones themselves, which are termed the nutritious canals: the direction of these canals varies in different bones, and will be noticed when describing the anatomy of each particular bone.

Another kind of cavity found within the interior of the bones more especially belongs to the bones of the head, and forms what are called the sinuses. The sphenoid, ethmoid, and frontal bones, each form such cavities, which seem to be produced merely by the separation of the outer from the inner table of the bone, small bony bands proceeding from the one table to the other, so as to produce a cellular appearance. Precisely the same organization may be observed in the medullary canals of the long bones.

Structure and Texture of Bones.

The structure of bones, like that of most other parts of the human body, is fibrous: the fibres are either so arranged as to form laminæ more or less compact, or so interwoven as to constitute a cellular or reticulated tissue. The fibres, then, which may be considered as the basis of the bony structure, differ from the fibrous structure of every other part of the body, only, in containing a portion of earthy matter. But this fibrous and earthy matter, which are observable in every bone, are not to be considered as constituting two different tissues, but rather as two constituents of one and the same tissue.

The density of the osseous system, its great characteristic, is not found to be the same in all bones, nor even in the different parts of one and the same bone. It is with regard to the different density of their tissue, that the different parts of bones are distinguished into the compact or cortical, spongy or areolated, and cancellated. These three textures are well exemplified in the long bones, which are compact in their bodies, spongy at their extremities, and cancellated in their interior. In the flat bones the two surfaces consist of the compact substance, whilst these two compact laminæ are separated from each other by a middle layer of spongy structure, which is termed the diploe, and is generally in proportion to the thickness of the bone.

The short bones are found to be of a spongy texture, principally surrounded by a thin lamina of compact bone.

The disposition of the fibres differs in different bones: in the long bones they run in lines parallel to each other, forming laminæ: in the flat bones they radiate, and in the short or irregular bones they are internately interwoven with each other: all which peculiarities remain more or less apparent through every period of life. It may also be observed, that these fibres have a greater tendency to increase in length than in breadth, and more especially at the earlier periods of life. Notwithstanding the hardness and solidity of bones, they nevertheless possess a degree of elasticity, which may be considered as answering an important purpose in the animal economy; for this elasticity tends to prevent fracture, and injurious pressure upon important viscera, from external injury: and further, enables a bone to resume its natural situation when displaced by the pressure of a tumour, as is seen in cases of polypus nasi.

General Physiology and Production of Bones.

Although the frequent attempts of the ablest physiologists have failed to explain the ultimate cause of ossification, and although nothing beyond mere hypothesis has hitherto been advanced on the subject, yet are we able to observe and describe the changes which succeed each other, before the bones appear in the human subject in their perfect hardness.

Those parts of the fœtus destined to constitute the osseous system, are found to undergo three distinct changes: from being originally in a fluid state, they change into a gelatinous consistency, secondly into a cartilaginous form, and thirdly, into a bony substance.

The process of ossification then commences, proceeds, and is completed in the following manner:—The first disposition of ossific matter is observed to take place in the substance of the original cartilage, but not on its surface; that portion of the cartilage immediately in contact with the osseous points becomes vascular, and, consequently, of a red colour. The osseous points, thus formed, gradually extend themselves from the centre to without,—the cartilage diminishing in a corresponding ratio, until at length it entirely disappears. The cartilage, then, is found to be absorbed as the bony structure is deposited: hence, ossification cannot, in strict propriety, be said to be effected by a deposition of an earthy matter into the previously formed cartilage, but, on the contrary, that the ossific process consists of an entirely new formation—a formation of a structure composed of an animal and earthy matter.

Shortly after conception, the whole of the bony system forms a transparent mucous mass, which is not converted into the cartilaginous state until two months of uterine gestation; at least, not in such bones as are late in their formation: some, however, which are essential to existence, immediately after birth pass through the changes alluded to, at a much earlier period, and with singular rapidity:—of this kind are the ribs and vertebræ. The ossification of the long bones also takes place very early in the fœtus; for, at the beginning of the third month, the bony cylinders are nearly completed: their extremities, however, continue in a cartilaginous state till a much later period. The flat bones of the cranium begin to ossify about seventy days after conception, at which period the dura mater is found highly vascular.

With respect to the process of ossification, as it proceeds in different bones, it is found in some to take place from the centre, and from thence gradually to extend to the extremities or sides; while in others, it commences and proceeds from several points at once. In the long bones, again, a different order is observed: in these, ossification takes place in the body from several points at once, and proceeds from these points as from so many centres. The extremities, however, of these long bones, which until the age of eighteen are called the epiphyses, are not perfected till that period, when the whole becomes completely ossified. The mode by which these epiphyses are ultimately connected, with the body of the long bones by ossific deposit, is precisely the same,—various centres of ossific matter uniting with each other, as in the rest of the bone: but the process is much slower, and, as has been observed, is not completed until the age of eighteen, at which period we suppose a harder substance than cartilage is necessary to support the weight of the body, and meet the increase of muscular action.

The epiphyses of the lower are ossified earlier than those of the upper extremities. The projecting apophyses of bones also undergo a process similar to that which takes place between the epiphyses and the long bones,—all such processes being originally united to the bodies of the bones by an intervening cartilage, as may be seen in the growth and developement of the trochanter major. The cancellated structure of bone is not completed until the epiphyses have disappeared.

With respect to the growth or increase of different bones, this proceeds, in long bones, not only by the successive deposition of new bony matter around that which has been already formed, but also by the lengthening of the bone at its extremities. The increase of the flat bones takes place much in the same manner, by a successive addition of osseous substance at the edges of the bone, as is seen in the bones of the cranium, and by the convertion into bone of the epiphyses which cover their margins, as may be observed in the scapula and bones of the pelvis. In thickness all bones increase from the periosteum.

Although the bones grow in breadth, as well as in length, they are found to increase more rapidly at their extremities than at their circumference. It is further found, that bones attain their perfect formation in the same order as they followed in their growth; and that, therefore, those parts of a bone which first began to ossify are the first to be completed. The cylindrical bones, with a few exceptions, form and perfect themselves sooner than the flat bones,—and these, again, sooner than the short bones. It is, moreover, a remarkable fact, that the bones which begin to ossify first, are also those that are soonest repaired after an injury.

After the bones have ceased to grow, which is not till after the epiphyses have disappeared, they undergo certain changes, the most remarkable of which is their decrease. This decrease is effected by an absorption of the interior of the bone, and hence it is that the medullary canal of the long bones, and the internal cancellated structure of the flat and short bones, are constantly increasing,—and hence, also, the reason why the skeleton of an aged is much lighter than that of a young subject.

The articular surfaces of the bones of the inferior members, and of the vertebræ, become, in old age, enlarged and flattened, as if, from the continued pressure of the weight of the body, they had at last yielded. The same cause produces a similar effect upon the neck of the femur, which, in advanced life, is always found so depressed as to form a right angle with the shaft of the bone, whilst, at an earlier period, it rises and projects at an angle of 40°.

The following tissues belong essentially to the organization of bones:—The *periosteum, medullary membrane, blood-vessels, nerves, and absorbents.* The membranous covering which is common to the whole osseous system, is generally, but not in all situations, termed periosteum,—for on the bones of the skull it receives the name of *pericranium.* The natural colour of this membrane, whether under the name of periosteum or pericranium, is white; and the numerous small vessels which ramify upon it, are afterwards distributed to the bone itself. Nerves, as well as absorbents, may also be traced upon the periosteum: although in a healthy state it appears to be insensible. The habitual production of osseous matter, after the bones have attained their perfect growth, takes place by laminæ, in the same manner as in their original formation, by a deposition from the periosteum. This mode of formation of bone from the periosteum may be very satisfactorily shewn, by feeding an animal with food mixed with madder. After a certain time, the bones are so impregnated with the madder as to be coloured by it. On leaving off the madder, the bone is observed to resume its natural appearance from without to within, which arises from a fresh deposition of bone from the periosteum. The colouring of the bone, according to Mr. Rutherford, is the result of a chemical affinity existing between the colouring matter of the vegetable and the earthy particles of the bone. It has also been shewn, by an experiment made by Mr. Hunter, who, on surrounding a bone with a ring, found that it gradually made its way towards the medullary canal of the bone: fresh depositions having taken place without, whilst absorption was going on in the interior.

The *medullary membrane,* which is highly vascular, contains the marrow, and serves as an internal periosteum to the bone it lines.

The *blood-vessels* of the bones are very numerous, and are sufficiently large to admit injection, so as not only to prove their existence, but even to indicate their minute course. They differ much in size, and are distinguished into those which first ramify on the external periosteum, and then penetrate the substance of the bone, and into such as, without first ramifying, penetrate at once into the medullary canal, and, spreading themselves upon the lining membrane, pass through its substance, and anastomose with the vessels of the compact structure. The *veins* which accompany the arteries, communicate very freely with the medullary cavities of the spongy structure of the bone.

Although *nerves* cannot actually be traced into bone, the pain incident to bones in disease sufficiently indicate their presence; and although, therefore, we have not, from our sensations, any conscientiousness of an osseous system, until some disease or accidental injury take place in it, yet the bones are really as capable as any structure in the body of warning us promptly, through the medium of the nerves, of injury inflicted upon them by motion or weight.

Absorbents cannot be demonstrated passing into bones, but the phenomena attending exfoliation and other diseases, sufficiently indicate their existence in that system.

It may be observed, in conclusion, that the osseous system generally undergoes certain changes at the different periods of life. It is found more spongy and soft during infancy, only resembling a fibrous tissue, in which there may be observed the incipient deposition of earthy matter. As regards their external form, bones are generally found to have a more rounded shape during the earlier than the more advanced periods of life: their eminences and depressions are less marked, and their surfaces have, in general, a more uniform appearance. In early life their great flexibility is an important quality; for it is owing to this quality that external violence produces but a comparatively slight and transitory effect on the bones of a young person.

Composition of Bone.

Bone consists of animal and of earthy particles, which, according to some physiologists, are supplied by two distinct sets of vessels: the former, or animal particles, being secreted by the blood-vessels which supply the internal or medullary membrane of the bone; whilst the latter, or earthy particles, are deposited by those of the periosteum or external investing membrane of bone. These two distinct constituents of bony substance may be easily demonstrated. For this purpose, if a portion of bone be exposed to a great heat, its animal particles will be consumed, leaving only an earthy residium: whilst, on the other hand, if bone be submitted to the action of dilute (nitric) acid, its earthy particles will be removed, and with them the *hardness* and *density* of the bone, although the remaining animal matter will be sufficient to retain the original *form* of the bone. Of course it is according to the preponderance of the earthy over the animal particles, that constitutes the relative hardness of bones; whilst their deficiency proves a cause of morbid softness. It ought, however, to be observed, that the bones of the fœtus are naturally soft from a preponderance of animal matter, as has already been shewn when speaking on the subject of the physiology of bone.—The following is the analysis of bone, as given by Bergelius.

Cartilage	34	17
Fluate of lime	2	00
Phosphate of lime	51	04
Carbonate of lime	11	30
Phosphate of magnesia	1	16
Soda, muriate of soda and water . .	1	20

Messrs. Fourcroy and Vanquelin state, that phosphate of magnesia, which is found in the bones of the lower animals, does not exist in the bones of the human subject; whilst, on the other hand, this salt is found in human urine, but not in that of brutes.

The relative proportion in the constituent parts of bone is not the same throughout the skeleton, nor even in one and the same bone at different periods of life. It is to these circumstances that are to be ascribed the sensible changes observed to take place, as well in the color as in the texture of bone, at the different ages of the human subject. Thus we find them blue and soft, in infancy; white and hard, in the adult; yellow and brittle, in old age. The yellow color of the bones in old age is, however, in part owing to the deposition of an oily matter into their substance. In speaking of the composition of bones, it may not be improper again to allude to what may be numbered with their appendages. Externally, they are covered either by periosteum or cartilage; internally, by a medullary membrane. The periosteum furnishes a membranous covering to the bones generally. Cartilage covers the extremities of such bones only as are destined to enter into the construction of joints. The medullary membrane performs a two-fold function: it assists in the nourishment of the bone itself, and secretes the marrow contained within the interior of the bone. This marrow has an oily consistence, but does not present the same appearance or the same characters in all bones: in long bones it is solid and compact, in the short bones it is fluid: indeed, some have contended that during life the marrow is always in a fluid state, and only congeals after death, but in some bones sooner than in others. In the long bones the marrow is lodged within the medullary membrane; whilst in the short bones that membrane is wanting, the marrow being deposited in the cancellated structure of the bones themselves.

Marrow is formed at an early period of ossification: it is of a redder color and most fluid in infancy: it becomes more copious and more extensively diffused till adult age; and is supposed by some to assist in nourishing the body generally, and in decarbonising the blood.

Reproduction of Bone.

The process by which bone is generated, after injury or disease, is precisely analogous to that by which the bones are originally produced. The vessels of the bones, and even the other structures surrounding them, if the separated parts be but approximated, soon throw out a gelatinous fluid, which hardens by degrees, and is in time converted into cartilage. In the interior of this cartilage, bony nodules are in a short time observed to form; which, uniting with each other as well as with the injured parts, form a medium of union for the detached portions; indeed, this process is observed to take place, even when the fractured parts are not brought into actual contact with each other, provided no solid substance intervenes. After reproduction of a part of a bone has been effected, the medullary cavity of that bone is found to be divided by a solid partition into two cavities, presenting an appearance as if the bone had originally consisted of two pieces. But after injury this process of reproduction does not always take place,—the failure depending upon either mechanical or constitutional causes, or both; such as a cachetic habit, or want of apposition and rest of parts. Generally, however, it may be considered that there is no solid in the body which has equally the power of reproduction as bone; for, in solution of continuity, it soon repairs itself by a substance entirely resembling the original bone, not only in its form and texture, but also in its chemical composition.

Accidental Ossification.

There are certain of the soft structures of the body, which are liable to accidental or unnatural depositions of bony matter, as the dura mater, pericardium, and even muscle. It generally happens, however, that the proportions of the animal and earthy parts are not the same as in original bone. These deposits being sometimes as hard and polished as the enamel of the teeth, at other times soft and cretaceous, resembling moistened chalk. The former are most common on serous membranes, whilst the latter are not unfrequently met with in abscess of the lungs, in the uterus and ovaria.

Diseases of Bone.

The bones, as well as the softer parts of the human body, are liable to disease; and, like other parts, are susceptible of inflammation, and of the usual consequences of that process, whether it arise spontaneously or be caused by external violence. When they sustain a solution of continuity, the separated parts are susceptible of re-union, by a process of reparation analagous to that which takes place in the softer substances of the human body, if affected in a similar manner. Bones, however, fall more slowly into disease than the softer parts, and their restoration is proportionably more tardy: they receive their nutriment chiefly from the periosteum; and hence it is, that disease or injury to that membrane immediately affects the bone itself—a circumstance that should ever be borne in mind by the surgeon when operating upon bone; for it is scarcely possible that any very extensive destruction of periosteum can occur without exfoliation of the bone itself.

However, it is not my intention to enumerate all the diseases to which bone is liable, as I should then encroach upon the province of surgery, rather than adhere strictly to the duties of an anatomical writer; yet I would wish to direct the attention of my readers to the similarity of the diseased action of every structure in the body; and although this idea may appear difficult to comprehend at a first view of the subject, still, if we remember that, even in structure, bone differs only from the softer parts of the body in having earthy matter superadded to its other constituent parts, the mystery is much diminished: and, moreover, it is found that the bones are liable to disease in proportion as their animal substance preponderates over their earthy particles. Hence, in youth, we find them much more frequently affected than at later periods of life.

LECTURE II.

THE BONES OF THE HEAD.

Description of the Skeleton.

When the bones of any animal are placed in situ, and deprived of their soft parts, the whole is called a skeleton; which is termed natural or artificial, as they happen to be attached to each other by their own ligaments or by wires. The artificial skeleton is best adapted for anatomical observation, as it admits of the motion of the limbs, and therefore is more suited to give a just idea of their uses.

The human skeleton has a strong resemblance to the figure of the body, and conveys at one glance a just idea how admirably it is adapted to its particular uses, especially in regard to the defence which it affords to the vital organs. It presents two large cavities:—the superior one, produced by the flat bones of the skull, prolonging itself through the vertebral canal, lodges the whole of the central parts of the nervous system: while the large anterior cavity, formed by the bones of the thorax and pelvis, sufficiently guards the organs for respiration and nutrition.

To facilitate the description, it is convenient to make of the skeleton three principal divisions:—*head, trunk,* and *extremities*—each of which are composed of several bones, so arranged as readily to indicate the functions for which they are destined.

The *head* is subdivided into the bones of the *cranium* and *face,* which will hereafter be particularly described.

The *trunk* is subdivided into the bones of the *spine, chest,* and *pelvis.*

The third division of the skeleton, the *extremities,* are divided into *superior* and *inferior*. The former are attached to the sides of the chest, and are composed of the bones of the *shoulder, arm, fore-arm,* and *hand:* while the inferior extremities, which are placed immediately under the pelvis, and give support to the rest of the body, are subdivided into the bones of the *thigh, leg,* and *foot.*

The Head.

By the head is meant all the spheroidal portion of the skeleton, which is placed above the first cervical vertebra, and necessarily comprehends the bones of the cranium and face. The cranium consists of several bones, which, in conjunction, form a vaulted basin for the purpose of defending the brain and its membranes. This bony cavity is invariably of a capacity in proportion to its contents, and is necessarily variable in its size.

The roundness of the cranium renders it better fitted to protect as well as to support the vital organ it contains, and is produced by the equal pressure of the brain upon the bones during its developement: this roundness, however, is prevented in the lateral inferior regions of the skull by the greater hardness of the temporal bones, as well as by the action of the temporal muscles, which have a great power in producing this effect; for the skull does not acquire its flatness until the muscles are sufficiently strong to produce it: hence the skulls of infants are much rounder than in after life.

The advantages derived from this lateral flatness, are an extended sphere of vision, and a more favourable position for the external organs of hearing.

The convex vertex of the cranium is quite smooth, and is covered by the pericranium, a thin aponeurotic expansion, and skin; while the external surface of the base is irregular, affording eminences and depressions for the attachment of the bones of the face anteriorly, and for muscles posteriorly. The internal surface of the cranium offers no greater irregu-arities than to correspond with the uneven superficies of the brain, with some few grooves for lodging the blood-vessels of the brain and its membranes.

It is worthy of remark, that the exterior table of the bones of the skull does not offer eminences corresponding to the internal depressions, in consequence of an intervening cancellated structure, but which however is diminished in those situations in proportion to the depth of the internal depressions—an observation pathologically valuable in reference to the application of the trephine.

In the base of the skull many outlets are found, termed *foramina*, allowing the transmission of nerves and blood-vessels.

It has already been observed, that the bones of the skull are composed of two laminæ, with an intervening cancellated structure called the diploe; but it should further be noticed, that the external table is thick and fibrous, and the internal compact and thin: which circumstances tend to render the bones a better defence to the brain, upon principles which will be explained hereafter.

The cranium consists of eight bones; six of which are usually described as proper to its cavity, and two common to it and the face: but, upon consideration, it is difficult to understand the legitimacy of this division; for, in truth, the reverse seems to be the fact, viz.: that only two, the parietal bones, can strictly be described as proper to the cranium, and the remaining six as common to the head and face.

The eight bones which enter into the composition of the cranium, are the os frontis, which occupies the anterior part of the skull; the two ossa parietalia, which form the upper lateral portions and vertex; the os occipitis, which is situated behind and at the base; the two ossa temporum, forming the inferior lateral portions and part of the base of the cranium. The os ethmoides occupies the fore part of the base, which is completed by the os sphenoides, situated in the centre of the base.

It may moreover be observed, that the frontal, occipital, ethmoid and sphenoid are azygos bones, and are placed in the mezian line of the body; while the parietal and temporal bones are in pairs, and are situated laterally.

The bones of the head are connected with each other by sutures, of which I shall now give no further account than their name and situation, leaving their minute anatomical structure to be described under articulations in general.

The Sutures.

The principal sutures are the coronal, the sagittal, lamboidal, and two squamous; and of inferior importance, at least in a pathological view, we may mention the transverse ethmoidal and sphenoidal sutures. These sutures connect the bones of the skull in the following manner.

The coronal suture connects the frontal with the two parietal bones: it begins at the anterior junction of the parietal bones, and extending downwards on each side, terminates in the squamous suture about an inch behind the external angle of the orbit.

The sagittal suture connects the two parietal bones in the middle line of the vertex, extending from the coronal suture before to the lambdoidal behind.

The lambdoidal suture commences at the posterior junction of the two parietal bones, connecting them with the os occipitis: it extends itself downwards on each side, as far as the posterior boundary of the squamous suture, and there seems to terminate; although a prolongation of this suture serves to connect the remaining portion of the occipital with the temporal bones, under the name of the additamentum suturæ lambdoidalis.

The squamous sutures, so called from one bone overlapping the other, extend from the coronal suture before to the lambdoidal behind, uniting the temporal with the parietal bones. A continuation of this suture, uniting the temporal with the sphenoid bone, is termed, by some anatomists, the additamentum suturæ squamosæ; but it should be observed that this overlapping of bones is not peculiar to the temporal bone, but appertains to all such bones as admit of the play of the temporal muscles over them.

The ethmoidal and sphenoidal sutures form the rough circumferences of the bones whose name they bear, and connect them with the other bones of the head.

The transverse suture connects the os frontis with the bones of the face, and will be more particularly pointed out,—as will the other sutures,—in the description of the union of the several bones of the face.

Having now taken a collective view of the bones of the skull, as far as refers to their junction, we shall proceed to their individual description.

The Os Frontis

Has its name from its alone forming that portion of the head we call the forehead. It has some resemblance to the cockle-shell when separated from the other bones: it is *convex* externally, and *concave* internally: smooth above, where it forms the forehead, but below, where it assists in forming the orbits, it affords several processes and eminences: the inner and concave surface is turned towards the brain. The processes and depressions which may be remarked on the external surface are, first, *two frontal eminences*, which mark the centres of ossification; *two frontal tuberosities*, marking the situation of the frontal sinuses; and *two superciliary ridges*, which overarch the orbit, give attachment to the occipito-frontalis muscle, and have the eye-brow placed on them: they terminate externally and internally in an *external* and *internal angular process*. Betwixt the two internal angular processes, a small process arises named the *nasal process*. Behind the external angular processes, a flat surface is observed, denominated the *temporal fossa*, on which the temporal muscle plays. From the under part of the superciliary ridges, portions of bone run a considerable way backwards: they are concave below to receive the ball of the eye, and termed therefore the *orbitar processes*. In each of the orbitar processes, upon their upper and outer part, behind the middle of the superciliary ridge, is a *depression* for the lachrymal gland: *a small pit* may be seen behind the internal angular process, where the pulley is fixed for the tendon of the superior oblique muscle of the eye to play around. Betwixt the two orbitar processes there is a large fissure, into which the cribriform plate of the ethmoid bone is admitted.

The *foramina*, observable on the external surface of the os frontis, are three on each side:—*One* on each superciliary ridge, a little on the inner side of its centre, named the *supra-orbitar foramen*, which gives passage to a twig from the opthalmic branch of the fifth pair of nerves, and a small branch from the internal carotid artery, to be distributed to the integuments and muscles of the forehead: but this opening is often found as a notch only. Near the middle of the inside of each orbit, sometimes formed in the transverse suture, where that suture attaches the orbitar process of the frontal with the ethmoid bone, is situated the *foramen orbitarium anterius*, which transmits the nasal twig of the first branch of the fifth pair of nerves, and a branch of the opthalmic artery. About an inch behind this, the *foramen orbitarium posterius* is placed, which is smaller than the anterior one, and through it a small branch of the ocular artery passes to supply the dura mater. Besides these there are a great number of small holes, which mostly only penetrate the first table, and admit of small vessels to the diploe, and the frontal and ethmoidal sinuses.

The *internal surface* of the os frontis is *concave*, except at the orbitar processes, which are *convex*, to support the anterior lobes of the brain: its surface is not so smooth as the external, for the arteries of the dura mater, and the irregular surface of the brain, furrow it. Through the middle of the internal surface, on the anterior half, there is a *ridge* for the attachment of the falx major, and through the posterior half a sulcus for the lodgement of the superior longitudinal sinus. Immediately at the root of the ridge, anteriorly, there is a hole called the *foramen cœcum ;* in this a small process of the falx is situated, and the superior longitudinal sinus begins there ; this hole is sometimes formed partly by the crista galli of the ethmoid bone, so as to render the foramen common to the two bones.

The os frontis is composed of two tables and an interposed diploe ; it is nearly equally dense throughout, excepting at the orbitar plates, which are rendered thin by the pressure of the brain on one side, and the globe of the eye on the other. In that part above the superciliary ridges, where the frontal tuberosities are described, the *frontal sinuses* are situated: they are formed by a separation of the external from the internal plate, and the absence of diploe; they are divided by a bony partition, but generally not into equal sized cavities: the partition is by no means always perfect. The frontal sinuses open into the middle chamber of the nose.

Connexion.—The upper circular part of the os frontis is joined to the ossa parietalia, from one temple to the other by the coronal suture: from the termination of the coronal suture to the external angular process, it is connected with the sphenoid by the sphenoidal suture ; at the external canthi, its external angular processes are joined by the transverse suture to the ossa malarum, to which it adheres one third way down on the outside of the orbits, whence to the bottom of these cavities, and a little upon their internal sides, the orbitar processes are connected with the sphenoid bone by the same suture. On the inside of the orbit, the ethmoid and the unguis are joined to the orbitar plate of the frontal bone. The transverse suture afterwards joins the frontal bone to the nasal processes of the superior maxillary bone, and to the nasal bones ; and lastly, its nasal process is connected with the ethmoid bone.

Use.—Serves to defend and support the anterior lobes of the brain ; assists in forming the bony part of the organs of vision and smell. In the fœtus it is not perfectly ossified; the superciliary holes are not formed, nor are the frontal sinuses.

Attachment of Muscles.—The muscles attached to the frontal bone are the temporales, corrugatores supercilii, orbiculares palpebrarum, and occipito-frontalis.

Points of Practical Importance connected with the Frontal Bone.

The *frontal eminences* are not to be considered as merely the points at which ossification commenced, but from their projecting form, and necessarily additional quantity of bony matter, as affording an additional defence to the anterior part of the brain.

Frontal prominences, which mark the situation of the frontal sinuses, do not offer the same dangerous symptoms from depression, in consequence of fracture, because of the separation of the laminæ in this situation. Bleeding at the nose, and extravasation of air, are the diagnostic marks of this accident. A mucous membrane lining the frontal sinus, renders this part liable to disease incident to the membrane. Thinness of the orbitar process leaves the brain dangerously accessible to a sharp instrument entering the orbit. The projection of the frontal spine in the interior middle line of the bone, and the continued groove for lodging the superior longitudinal sinus, excepting under unavoidable circumstances, unfit this part of the bone for the application of the trephine.

The Ossa Parietalia

Are two bones completely proper to the cranium, and forming its vertex, in shape of an irregular square, and when connected form an arch with its convexity placed externally, and its concavity internally. There may be distinguished upon each of these bones the following parts:—an *external* and an *internal surface, four edges* and *four angles,* as well as certain *eminences* and *depressions.*

The *external* surface of the bone is *convex,* more especially in the centre, where a prominence marks the commencement of ossification; immediately below the prominence is situated an *arched ridge,* crossing from before to behind, from which *radiated lines* pass down, converging towards the inferior edge, marking the attachment of the temporal muscle. The four edges of this bone are the *superior* or *sagittal edge,* which is serrated, and assists to form the suture common to both. By the side of this edge, near the centre, a *foramen* is formed, which transmits a vein, passing to the superior longitudinal sinus. The *anterior* or *coronal* edge, also serrated, forms, with the frontal bone, the coronal suture: the *posterior* or *lambdoidal* edge being in a similar manner connected with the occipital bone. The *inferior* or *squamous* edge differs from the others in being grooved, and is overlapped by the temporal bone.

The four angles are, the *anterior* and *superior*, or *frontal angle*; the *anterior* and *inferior*, or *sphenoidal angle*, which is the most lengthened of the four; the *posterior* and *superior*, or *occipital angle*; the *posterior* and *inferior*, or *mastoidal angle*. The whole of the external surface of the bone is smooth excepting at the edges.

On the *inner concave* surface, deep furrows are formed by the vessels of the dura mater; and at the anterior and inferior angle there is a canal for the middle artery of the dura mater or meningeal: there are several small holes leading to the diploe. Generally the lateral sinuses make a *depression* at the posterior and inferior angle of the bone: also a *depression*, which, by conjunction of this bone with its fellow, forms a groove, is seen at the superior edge, and lodges the superior longitudinal sinus.

Sinuosities, for the lodgement of the prominent parts of the brain, present themselves on this surface.

Connexion.—The ossa parietalia are the thinnest of the bones of the head, but have every where the diploe. They are *joined in front*, to the os frontis, by the coronal suture; at their inferior angle, to the *sphenoid bone*, by part of the suture of this name; at their *lower edge*, to the ossa temporum, by the squamous suture; *posteriorly*, to the os occipitis, by the lambdoidal suture; and *above*, to one another, by the sagittal suture. At the time of birth these two bones are separated from each other, and the opening is called the *bregma*: the pulsation of the brain may be felt here through the membranes.

Use.—The parietal bones form the superior, middle, and lateral parts of the skull, and are destined therefore to protect the superior parts of brain from injury, and to lodge a part of the longitudinal and lateral sinuses.

Attachment of Muscles.—Only one muscle is attached to the parietal bone, the temporal; the tendon of the occipito-frontalis passes over it.

Practical Remarks.

The application of the trephine should be avoided upon the two inferior angles of these bones: upon the anterior and inferior, in consequence of the situation of the middle meningeal artery of the dura mater; whilst the proximity of the lateral sinus to the posterior and inferior angle, would render its application there dangerous. The superior longitudinal sinus must also be avoided; and indeed the variety in the thickness of the bone, in its different parts, would imply the necessity for great caution in the application of the trephine on every part of this bone.

The Os Occipitis.

This bone forms the posterior paries of the cranium, and also a portion of the base. It derives its name from its situation; and, like the other bones of the skull, presents an external convex and an internal concave surface. Its figure is rhomboidal, having the upper angle slightly rounded; the two lateral angles are obtuse, while the lower one projects forwards, forming a part of the base of the skull, and is connected with the sphenoid bone.

The occipital bone is, at birth, divided into four distinct portions: the upper of these is the largest, comprising all that part of the bone situated above the foramen magnum: its shape is triangular. The two lateral portions are symmetrical, and are situated at the side of the great foramen, and constitute the condyles. The fourth piece forms the anterior part of the bone, completes the foramen, and projects forwards to form the cuneiform process. The description of the bone is facilitated, by giving a distinct anatomical account of each of these parts separately.

The *occipital,* or *upper portion,* presents an *external* convex surface, on which we observe two *transverse arched ridges*—a superior and an inferior. In the centre of the superior is a prominence, called the *tubercle* of the occipital bone; and extending downwards from the tubercle, in the median line, as far as the foramen magnum, we find a sharp ridge, called the *occipital spine.* This spine bisects the inferior arched ridge at right angles, and is most prominent at the lower part. On either side of the tubercle, and between the arches, the bone is rough for the attachment of muscles, which are connected in the following order:—To the upper transverse ridge are attached the m. occipito-frontalis, the m. trapezii, and part of the m. sterno-cleido-mastoidei. The space between the arches is occupied by the m. splenii and m. complexi; while into the inferior are inserted the m. recti capitis postici majores, and m. obliqui capitis superiores. Immediately above the foramen magnum, and on either side of the spine, are two slight pits, which receive the insertions of the m. recti capitis postici minores.

The *internal surface* of this upper portion of the occipital bone presents a concavity, divided into *four compartments* by a *perpendicular* and an *horizontal groove,* which bisect each other at right angles. At the point where they cross is situated an *internal occipital tubercle,* below which the vertical groove generally forms only a spine, continued down to the foramen magnum, which is termed the *internal occipital spine;* it gives attachment to the falx minor. To the groove above the tubercle is attached the falx major, and within it is lodged the superior longitudinal sinus; while the lateral grooves give connection to the tentorium, and receive the lateral sinuses in their cavities. Above the tentorium, and consequently above the lateral grooves, the posterior lobes of the cerebrum are situated; and, in the concave compartments below, the cerebellum is lodged. The whole circumference of this portion of the bone is serrated to form the lambdoidal suture, frequently presenting irregularities from the presence of ossa triquetra.

The *lateral parts* or *condyloid portions* of the occipital bone, are, *externally,* irregularly convex; *internally,* irregularly concave. On their convex surface are seen the projecting processes called *condyles,* which articulate with the atlas. They have their long axis, from before to behind; converge anteriorly; and have their inner edges deeper than their outer, to prevent lateral motion. A rough line marks the circumference of the condyles, for the attachment of the capsular and lateral ligaments connecting this bone with the atlas. Behind each condyle is a fossa, filled with fat, from which open the *posterior condyloid foramina,* giving transmission to veins passing from the exterior of the cranium to the sinuses of the brain. To the outer side of the condyles we find an *irregular projecting portion of bone,* rough on the external surface, for the attachment of the m. rectus capitis lateralis, and marked within by a deep *sulcus,* which lodges the termination of the lateral sinus: its edges are rough, to connect it with the petrous portion of the temporal bone; and anteriorly it is hollowed out into a notch, which forms part of the foramen lacerum basis cranii. To the inner side of this notch, and immediately before the condyles, are the *anterior condyloid foramina,* for the transmission of the lingual nerves.

The fourth, or *cuneiform portion* of the occipital bone projects forwards from the foramen magnum, and seems produced by the junction of the lateral pieces. It is, as its name implies, of a wedge-like shape; its narrowest portion being situated anteriorly, where it is connected with the sphenoid bone. The posterior boundary of this process is concave, forming the anterior part of the foramen magnum: the anterior boundary, for its union with the sphenoid bone, is rough. Laterally it presents *irregular edges,* where it joins with the petrous portions of the temporal bones; and here a partial *groove* may be seen, completed by the temporal bone, for lodging the inferior petrosal sinuses. The *internal surface* of the bone is smooth, and slightly *hollowed,* to receive the medulla oblongata: the *exterior* is rough, giving insertion to the m. recti capitis antici majores et minores: anteriorly to which are attached also the superior and middle constrictors of the pharynx, of which cavity this bone forms the upper boundary.

The junction of these four portions of the occipital bone with each other, forms that large opening called the *foramen* *magnum;* which is, consequently, bounded before by the cuneiform, behind by the occipital, and laterally by the condyloid portions. The *foramina,* which we have already noticed, should now be described collectively: they consist of two pair and a single one *proper* to the occipital bone, and one pair *common* to it and the temporal bone.

The *proper* are the foramen magnum, and the anterior and posterior condyloid foramina. The foramen magnum transmits the spinal marrow with its membranes and vessels, and allows the entrance of the vertebral arteries and accessory nerves. The anterior condyloid foramina are important, from giving transmission to the lingual nerves: the posterior merely allow the passage of small veins, and are occasionally wanting, in which case the veins pass through the foramen magnum. The pair of foramina *common* to this bone and the temporal are the *foramina lacera basis cranii,* giving exit to the internal jugular veins, the pneumo-gastric, glosso-pharyngeal and accessory nerves. These foramina are sometimes divided into two by a thin lamina of bone.

This bone is amongst the thickest of the cranium, but unequally so, being partially rendered thin by the brain within, and the action of the muscles without.

Connexion.—The occipital bone is connected above, with the ossa parietalia, by the lambdoidal suture; laterally, with the temporal bones, by the additamenta suturæ lambdoidalis; and anteriorly, by the extremity of the cuneiform process, with the sphenoid bone, in the same way that epiphyses and their bones are joined: for, in the young subject, a cartilage is placed between them. Lastly, it is connected below, by a double articulation, with the atlas, each condyle being received into the superior articulating cavity of that vertebra.

Attachment of Muscles.—Muscles attached to the os occipitis are the occipito-frontalis, trapezii, sterno-cleido-mastoidei, splenii, complexi, recti capitis postici majores, minores et laterales, obliqui superiores, recti capitis antici majores et minores, constrictores pharyngis superior et medius.

Practical Remarks.

The variety of thickness in this bone should be kept in mind while examining it in case of injury. The ossa triquetra, which are insulated portions of bone produced by variations in the course of the lambdoidal suture, sometimes offer such irregularity of surface, as might lead to a suspicion of injury to the bone where it did not exist. From its connexion with the first cervical vertebra, this bone differs from all those already described, by its liability to the diseases incident to moveable articulations.

The only situation in which the trephine can be safely applied to this bone, is in the space above the tubercle on either side of the median line, in consequence of the situation of the sinuses, above, and the thick layer of muscles below the tranverse ridge.

The Ossa Temporum

Are situated at the sides and inferior part of the cranium, containing within them the organ of hearing: they are said to be so called from the hair situated on them first becoming grey, and thus denoting age in the individual. Each os temporis may be divided into two portions: the upper one thin and smooth, terminates in a semicircular edge, which, from its peculiar connexion with other bones, is called the *squamous* portion. The lower portion, situated at the base of the skull, is hard, and forms a protuberance irregularly triangular: this contains the organ of hearing, and is denominated the *petrous portion.*

These bones present an external irregularly convex, and an internal concave surface.

There are five processes on the external surface of each temporal bone which may be described: the first, situated at the lower and posterior part of the bone, called, from its resemblance to the nipple, the *mastoid process:* this is externally hard, but is composed internally of cancelli, which have communication with the cavity of the tympanum: it has three muscles attached to it: the sterno-cleido mastoideus, trachelo-mastoideus and splenius—all inserted into it. Anterior to the mastoid, a second process begins to rise out of the bone: it is directed obliquely forwards about *two inches* in length, and terminates by joining the os malæ, forming an arch under which the temporal muscle passes: this is called the *zygomatic process.* The upper edge of this process is somewhat rough for the attachment of the strong aponeurosis of the temporal muscle, and the lower edge has arising from it a part of the masseter muscle. From the under part of the bone, below, and between the other two processes, the third process projects, pointing downwards, and from its form is denominated the *styloid process:* it is various in its length in different subjects; and is sometimes found, in advanced age, to be of such a length as to be connected by bone to the os hyoides. Three muscles have their origin from this process, and are partly named from it:—The stylo-glossus, stylo-hyoideus, and stylo-pharyngeus: a ligament of the os hyoides is also attached to it, a portion of which extends to the angle of the jaw. This process in youth is principally cartilage, and at the adult period is frequently not entirely ossified.

These are the three principal processes of the temporal bone: but there are still two others, which, as they are invariably present, should be mentioned. Round the root of the styloid process, but more particularly anteriorly, there is a remarkable rising of bone which is called the *vaginal process:* it is rough and gives attachment to the internal lateral ligament of the lower jaw.

The fifth process is the *auditory,* which is irregular, and assists in giving a firm attachment to the cartilages of the ear, as well as to the external lateral ligament of the tempero maxillary articulation: it reaches from the anterior part of the mastoid to the root of the zygomatic process, and forms the lower part of the rim of the meatus auditorius externus.

Five *depressions,* or *fossæ,* are observable on the external surface of each temporal bone.

A considerable fossa is found immediately on the inner side of the mastoid process, from which the digastric muscle arises; hence it is termed the *fossa digastrica.* Also anterior to the root of the zygomatic process, the *fossa temporalis* is situated, which depression marks the position and even the direction of the fibres of the temporal muscle: it is this depression which forms the posterior boundary of the zygomatic arch. Between the auditory, vaginal, and zygomatic processes, there is found a large cavity divided into two distinct fossæ by a fissure termed the fissura glasseri: the anterior is lined with cartilage and receives the condyle of the lower jaw, and is denominated, therefore, the *fossa condyloidea,* the long axis of which is from side to side, corresponding to the form of the condyloid process of the lower jaw. The posterior fossa lodges a considerable portion of the parôtid gland, and is termed the *fossa parotidea.* The close attachment of the parotid gland to the lower jaw, sufficiently explains how its secretion is influenced by the motions of that bone. These fossæ are separated from each other, not only by the fissura glasseri, but also by the attachment of the capsular ligament of the temporo-maxillary articulation. The fifth fossa is the *fossa jugularis:* it is placed immediately on the inner side of the styloid process, whence begins the internal jugular vein from the termination of the lateral sinus.

The particular use of these depressions is sufficiently explained in the description given of each of them.

The *foramina,* which are usually found upon the external surface of the temporal bone, are five in number, and are *proper* to it: but besides these are to be borne in memory the notches which are formed into foramina, *common* to the temporal and other bones, to which it is connected, as the foramen lacerum basis cranii anterius, et posterius, and the canalis caroticus.

The five foramina proper to the temporal bone, are, first, the *foramen auditivum externum,* which is situated between the mastoid and zygomatic processes, immediately above the auditory: this foramen leads from the external ear to the cavity of the tympanum, it gives attachment to the cartilages of the ear, and conveys sound to the bones in the cavity of the tympanum. It is frequently termed the meatus auditivus externus.

The second foramen is situated between the styloid and mastoid processes, and is consequently called the *foramen stylo-mastoideum:* it is, in fact, the termination of the canal of Fallopius, and allows of the transmission of the portio dura or facial nerve.

Somewhat anterior, and rather to the inside of the styloid process, is found the third foramen, but which, from its tortuous course, is to be considered rather as a canal. It is through this foramen that the internal carotid artery enters the skull, and is termed, therefore, the *foramen caroticum.* It also admits the filaments of connexion between the sympathetic and the fifth and sixth pairs of cerebral nerves: there are small foramina leading from this passage to the internal ear, and, through these, small arteries pass, which have been particularly described by Valsalva as the proper arteries of the tympanum.

On the anterior edge of the petrous portion of the temporal bone, at the very point of junction of this part of the bone with the squamous, and situated immediately above the inner opening of the carotid foramen, is placed the orifice of a canal which passes backwards and outwards to terminate in the anterior part of the tympanum: in the recent subject, partly composed of cartilage and partly ligamentous, it is continued to the pharynx, and is termed the *iter a palato ad aurem,* or *eustachian tube.* Immediately above the entrance of the eustachian tube, and separated from it by a thin lamina of bone, is a small canal of minor importance, through which the tendon of the tensor tympani passes into the tympanum.

The fifth foramen is the *foramen glasseri,* which is situated a little above the centre of the fissure of that name, immediately posterior to the capsular ligament of the lower jaw: it allows of the passage of a small nerve which crosses the tympanum, and is termed the chorda tympani: it likewise gives entrance to the tendon of the laxator tympani muscle. There is, however, not unfrequently, another foramen found on the external surface of the temporal bone, just at the posterior rough edge of the petrous portion, which is called the *foramen mastoideum:* but this foramen is usually common to the temporal and oeeipital bones. Its use is to transmit a small vein from the exterior of the eranium to the lateral sinus, and sometimes a small branch of the oeeipital artery passes through it to supply the posterior surface of the dura mater.

The internal surfaee of the ossa temporum is very unequal, but, like the external, is divided into a squamous and a petrous portion. The squamous portion is irregularly eoncave, rises upwards, and terminates in a thin semilunar edge, whieh is serrated for its firmer attaehment to the parietal bones whieh it overlaps, produeing that kind of sealy attaehment from whieh this portion of the bone has derived its name. Immediately below the sealy serrated edges, the bone is marked by the convolutions of the lateral lobes of the brain, and is furrowed by the arteries of the dura mater.

The petrous portion on its internal surfaee is of a triangular form, and is direeted forwards and inwards, presenting an anterior surfaee, a posterior surfaee, an acute upper edge, and a broad surface below, which is irregular, and has been deseribed as forming a part of the exterior of the bone: the base of the triangle is attaehed to the squamous portion of the temporal bone, and the apex extends to the sphenoid, where that bone is joined to the euneiform proeess of the oeeipital. On the *anterior face* there are irregular *depressions* to reeeive the middle lobes of the brain: there is also a *slight depression* for the semilunar ganglion of the trigeminal or fifth pair of nerves. At the anterior and internal extremity of this faee, the *carotid canal* may be seen opening into the eavity of the cranium by the side of the sphenoid bone; and on the outer side of this, at the junetion of the petrous and squamous portions of the bone, the *eustachian canal* is placed, whieh has already been described: leading from it, and direeted upwards and outwards, passes *a groove* to the *foramen innominatum,* for the passage and transmission of a refleeted braneh from the seeond division of the fifth pair of nerves. On the posterior surfaee may be seen the *foramen auditivum internum,* whieh allows the transmission of the portio mollis and the portio dura; the former passing to the labyrinth of the internal ear, while the latter takes its course through the canal of Fallopius, and passes out of the foramen stylo-mastoideum as the facial nerve. The inferior edge of this surface forms a groove for the inferior petrosal sinus, which takes its course from before to behind, and terminates in the foramen lacerum basis cranii, which is only partly formed by the temporal bone, but completed by the junction of this bone with the occipital. There are also two small foramina seen on this surface of the bones: the first is placed immediately behind the foramen auditivum internum; it is leading from the vestibule of the internal ear, and is termed the *aquæductus vestibuli.* The other is rather to be described as being situated upon the inferior broad face of the bone, between the fossa jugularis and the carotid canal, being a passage from the cochlea, and is denominated the *aquæductus cochleæ.* These passages are supposed to be for the purpose of allowing the fluid, contained within the internal ear, to flow into the interior of the skull, when impressed by any violent sounds. The acute upper edge has, running from before to behind along its anterior half, a *groove* for the lodgement of the superior petrosal sinus, which leads downwards and backwards to terminate in the lateral sinus immediately above the fossa jugularis; while, on the posterior surface of this acute edge, there are seen unequal convexities, marking the situation of the semicircular canals. The *base* of the triangle is attached to the squamous part of the temporal bone; but immediately behind this junction is to be observed a deep *sulcus* for the lateral sinus, which forms the internal surface of the mamillary process. The apex of the triangle passes forwards to the sphenoid bone, and is rough in the recent subject, having cartilage connected with it.

The foramina of the temporal bone are to be divided into those which are proper, and those which are common to the temporal and other bones of the head.

The *proper* foramina are ten in number; five on the external surface, and five on the internal surface of the bone.

The external are the foramen auditivum externum, foramen stylo-mastoideum, foramen glasseri, foramen caroticum, and foramen eustachii.

The internal are the foramen auditivum internum, foramen innominatum, aquæductus cochleæ, aquæductus vestibuli, and the internal opening of the carotid canal, which is in part common to the temporal and sphenoid bones.

The *common* foramina are the foramina lacera basis cranii anterius et posterius, and the foramen mastoideum, which is sometimes however proper to the temporal bone; it is for the transmission of small veins from the exterior to the lateral sinus.

Connexion.—The temporal bone is joined by the upper and middle part of its thin serrated squamous edge to the parietal bone, while the anterior edge of the squamous plate connects it with the ala major of the sphenoid bone: at its mastoid process, by the additamentum suturæ lambdoidalis, it is joined to the occipital bone; and by the anterior extremity of the zygomatic process, to the malar bone. The petrous portion, in forming its part of the internal base, is connected anteriorly with the sphenoid and posteriorly with the occipital bone, while the apex is indirectly connected with the body of the sphenoid bone by cartilage: and lastly, by the glenoid cavity the temporal bone is articulated to the lower jaw.

Attachment of Muscles.—The m. sterno-mastoid, splenius capitis, and trachelo-mastoideus, are inserted into the mastoid process. The masseter is attached to the zigoma, the temporalis to the temporal fossa, to the digastric fossa the digastricus: the stylo-glossus, stylo-hyoideus, and stylo-pharyngeus to the styloid process, and lastly, to the apex of the petrous portion the levator palati, and tensor tympani are connected.

Use.—The temporal bones assist the other bones of the cranium in protecting the brain, and by the peculiar manner in which they are joined to the sphenoid and parietal bones, they offer every defence against injury from external violence; they form also foramina for the transmission of vessels and nerves, and produce, with the lower jaw, the temporo-maxillary articulation: by their junction with the malar bones a portion of the face is produced; and lastly, they contain the organ of hearing.

The Practical Points

Connected with the temporal bones are numerous, as we should be led to suppose when considering the important organs connected with them; as, for instance, the organ of hearing; rendering these bones therefore subject to the diseases of mucous membranes, and of the articulations of the small bones of the ear. In the treatment of these diseases I cannot refrain pointing out, as a caution, the close vicinity of the brain.

Fracture of these bones is usually indicated by bleeding from the ear.

Their connexion with the lower jaw renders them also liable to the diseases and injuries of their connecting articulation; and when the lower jaw is dislocated, the position of the condyle should be remembered under the zygomatic arch, the posterior tubercle of which assists in forming the glenoid cavity.

From the proximity of numerous important parts to these bones, as the parotid gland, arteries and nerves, sinuses of the brain and numerous muscles, the physiology and anatomy of the temporal bones should be particularly studied.

The covering which these bones receive from the temporal muscles, tends much to protect them from fracture; but when this accident does take place, owing to the brittle and compact structure of the squamous portion, the bone is generally so comminuted as to allow of the removal of the broken pieces by the forceps and Hey's saw, thereby rendering the application of the trephine unnecessary.

The Os Sphenoides.

This bone is excessively irregular in its form, so much so as to render it difficult to describe its figure. It has been thought to resemble, and has therefore been compared to the form of a bat, with its body, wings, and legs. It has derived its name from the manner in which it is wedged into the base of the skull.

It presents an irregular external *convex* surface, offering numerous eminences and depressions; and an internal *concave* one, more or less flattened or hollow, to receive the under surface of the middle lobes of the brain.

The external surface, at first view, offers three principal parts: the middle part, or *body,* the two *extending wings,* and the descending *legs;* but these are also described as wings, being named the pterygoid processes, although they much more resemble, both in situation and appearance, the legs of the animal to which the form of the bone is compared. As each of these parts presents numerous processes and depressions, I shall separately describe them.

The body forms the centre of the external surface of the bone, and offers an *anterior edge*, a *posterior surface,* and an *inferior surface,* the superior surface not being described until speaking of the internal part of the bone.

The anterior edge is serrated for its attachment with the ethmoid bone; immediately posterior to which edge are seen small cellular cavities, which complete the posterior ethmoidal cells by their junction with the ethmoid bone. The posterior surface is rough for its articulation with the occipital bone. The inferior surface of the bone presents, in its median line, a projecting process of bone termed the *azygos process;* which is produced by the junction of two thin plates of bone, termed the ossa triangularia, which cover the sphenoidal sinuses. This process projects upwards so as to divide the sinuses into two unequal parts, and downwards to form a part of the septum of the nose, by being received into the vomer. Laterally, the body of the bone is connected with the alæ and the legs.

The two *extending wings, or alæ majores,* stretch outwards to form the lateral boundaries of the bone, offering numerous irregularities for the attachment and lodgement of important parts, rendering their description essential. Upon the anterior and larger part of each wing we observe two smooth surfaces, separated by a middle ridge, to which the name of processes are given. The external surface is hollowed, forming a part of the temporal fossa, and is therefore termed the *temporal process:* the inner surface is also slightly hollowed, forms the outer part of the bony orbit, and is called the *orbitar process:* and the middle ridge is rough, for its attachment to the malar bone, and is denominated the *malar process.* Behind this is a groove for the passage of a nerve from the second division of the fifth pair. The posterior part of the ala major passes backwards in a wedge-like form, to be admitted between the squamous and petrous portions of the temporal bone, under the name of the *spinous process;* projecting downward, from which is a little process termed the *styloid process,* giving origin to the m. circumflexus palati. The outer edge of the wing forms a semilunar serrated edge for its attachment to the squamous portion of the temporal bone: but it should be observed, that the anterior part of this edge is overlapped by the temporal bone, while the posterior part, in its turn, overlaps the temporal. By which arrangement great mechanical strength is given to their union. The internal edge of the ala major is connected with the body of the bone, and forms anteriorly a part of the foramen lacerum orbitale superius.

The last processes to be observed on the exterior of the sphenoid bone are the legs, commonly called the *pterygoid processes;* although the term is erroneously applied, when we describe the bone as resembling the form of a bat. These processes come off from the junction of the body with the wings, and pass downwards perpendicularly from the base of the skull: they each consist of two plates, an external and an internal, joined together anteriorly, but separated behind, so as to form a hollow between them, called the *pterygoid fossa,* the concavity of which faces backwards: this fossa is filled up by the origin of the pterygoideus internus muscle. At their lower part the plates cease to be joined anteriorly, and rather diverge from each other to their termination: the space thus left between them is, however, filled up by the palatine bone. The external plate of the pterygoid process is the shorter and the broader, presenting an external surface, giving origin to part of the pterygoideus externus muscle, and an internal surface for the formation of the fossa. The internal plate is long and narrow, terminating in a slender curved projection called the *processus hamulus,* over which plays the tendon of the circumflexus palati muscle: its external surface corresponds to the fossa; its internal surface forms the posterior part of the inner wall of the cavity of the nose. At the anterior part of the pterygoid process, where the two plates are joined, we find, above, a slight concavity forming the posterior boundary of the spheno-maxillary fossa, a space between the sphenoid and maxillary bones, in which is lodged the superior maxillary nerve prior to its division. Extending downwards from this is a groove forming a part of the pterygo-palatine canal, and leading through the palato maxillary foramen to the roof of the mouth. On either side, and below this groove, the bone is rough for its attachment to the os palati. Lastly, the root of the pterygoid proces is traversed by the pterygoid canal, extending from before to behind, which allows of the transmission of a branch of the second division of the fifth pair of nerves.

We now proceed to speak of the internal surface of the sphenoid bone, which presents, besides the internal view of the body and wings, which have already been noticed as regards their exterior, also a third process, or rather a pair of processes, not yet spoken of, viz., the *alæ minores.* Thus, in giving a general description of the sphenoid bone, we might say that it consisted of a body and the two alæ majores *common* to both its surfaces; of the pterygoid processes *proper* to the external; and the alæ minores, *proper* to the internal surface. The *internal surface* of the sphenoid bone is irregularly concave, and supports the middle lobes of the brain.

On the *body* we observe a considerable hollow, called the *sella tursica,* from its resemblance to a Turkish saddle,—or *fossa pituitaria,* for lodging the pituitary gland of the brain. This fossa is bounded anteriorly by two small projecting processes of bone, termed the *anterior clinoid processes:* they are produced by portions of the roots of the alæ minores, and between them is situated a rounded ridge of bone, called the *processus olivaris;* from which are seen to pass two diverging grooves, which lead to the foramina optica, and mark the course of the optic nerves after they have formed their junction. Behind, the fossa pituitaria is bounded by the *posterior clinoid processes,* which project but slightly from an intervening plate of bone, which connects them one to the other in such a manner as to present generally rather a single than a double process.

At the sides of the sella tursica, running from behind to before, is found a groove for lodging the internal carotid artery, after it has emerged from the canal, and the cavernous sinus: this groove is continued upwards underneath the anterior clinoid processes, and is sometimes converted into a complete foramen for the passage of the vessel. Extending laterally from the body of the bone, are the internal surfaces of the alæ majores, hollowed out into numerous concavities to correspond to the convolutions of the brain, and grooved by the arteries of the dura mater: they project backwards in a triangular form to terminate in the spinous process of the bone, which has been described on the external surface, and which is admitted into the space between the squamous and petrous portions of the temporal bone. The alæ majores present upon their upper and anterior parts, a rough and somewhat triangular surface, for their attachment with the frontal and parietal bones: their outer semilunar serrated concavities, which receive the temporal bones, are as obvious upon this as the external surface of the bone.

The last processes to be described are the *alæ minores*, which arise broad from the anterior part of the body of the bone, and extending transversely outwards, terminate in slender pointed extremities, which are sometimes attached to the greater wings, and complete the foramina lacera orbitalia superiora: while, at other times, these two portions of bone are not connected, and the foramina are, in that case, completed by the junction of the frontal bone with the sphenoid. These slender pointed portions of the alæ minores are termed the *transverse spinous processes:* their posterior edge is smooth, and gives attachment to a process of the dura mater, which separates the anterior from the middle lobes of the brain: their anterior edge is rough, to be joined to the orbitar process of the frontal bone; and in the middle part, the alæ minores are connected by a thin plate of bone, which, posteriorly, is joined to the body of the sphenoid bone, and, anteriorly, to the ethmoid. This plate, or portion, may be called the *ethmoidal spine.* The superior surface of these alæ support the anterior lobes of the brain: their under surface forms a small part of the roof of the orbit posteriorly, and the foramina lacera orbitalia superiora, to which we have already adverted.

The foramina in this bone are numerous, and all consist of pairs: six pairs are *proper* to the bone, and four are *common* to it and other bones.

The six proper are, first, the *foramina optica,* which are situated at the junction of the roots of the alæ minores with the body of the sphenoid bone: they are directed forwards, outwards, and rather downwards into the orbit, and are for the passage of the optic nerves, and ophthalmic arteries of the internal carotid. Behind, and to the outer side of these are situated the *foramina lacera orbitalia superiora,* which are directed from within to without, and from below upwards. They are formed by the junction of the alæ majores and minores to the body of the bone on the inner side of the foramen, and to each other on the outer: sometimes, however, assisted, as has been before observed, by the frontal bone. These foramina communicate with the orbits, and allow of the transmission of the third, fourth, first division of the fifth, and sixth pair of cerebral nerves—all of which pass to supply the eye and its appendages: they also admit the ophthalmic veins to pass through them backwards from the orbit to terminate in the cavernous sinuses, which are situated immediately posterior to them. Directly under these foramina, and slightly posterior to them, are placed the *foramina rotunda,* which pass somewhat downward, and lead to the spheno-maxillary fossæ: they transmit the second division or superior maxillary branch of the fifth pair of nerves. Nearly an inch behind these, and external to them, are placed the *foramina ovalia,* for the passage of the third division of the fifth pair, or the inferior maxillary nerve: the names of these two last mentioned nerves indicate their distribution. Behind the foramina ovalia, and to their outer side, are found the *foramina spinosa,* which are small, and are named from their situation. They give passage to the middle artery of the dura mater, a branch from the internal maxillary of the external carotid artery. All these foramina pierce the bone, and therefore might be described as well on the external as on the internal surface: but there are two foramina *proper* to the external surface—the *foramina pterygoidea*—commencing before, from the spheno-maxillary fossa, and terminating posteriorly at the foramina lacera basis cranii anteriora. They transmit a branch of the second division of the fifth pair, which divides into two at the posterior opening of these foramina: one branch goes upwards into the skull through the foramina lacera basis cranii anteriora, and the other downwards into the carotid canal: and both of these openings are close to the foramina pterygoidea. I have mentioned these nerves only for the purpose of pointing out the exact position of the foramina. There are also to be observed openings of the sphenoidal sinuses, anterior to the processus azygos, on the external surface of the body of the sphenoid bone.

The foramina *common* to the sphenoid and other bones are the *foramina lacera basis cranii anteriora,* formed by the junction of the body of the sphenoid with the extremity of the petrous portions of the temporal bones; through which pass, as before described, a reflected branch of the second division of the fifth pair of nerves, and a small artery to the dura mater. The *foramina spheno-palatina* are produced by the junction of the roots of the pterygoid processes of the sphenoid with the neck of the nasal plate of the palate bones, immediately below their orbitar processes: they transmit the lateral nasal branch of the second division of the fifth pair of nerves into the nose, leading from the spheno-maxillary fossa, and also an accompanying branch of the internal maxillary artery.

The *foramina pterygo-palatina,* which run sufficiently far, rather to deserve the name of canals, proceed downwards from the spheno-maxillary fossa. They are formed at first by the two bones from which they have acquired their name, and afterwards by the maxillary and palate bones, and terminate in the upper and back part of the roof of the mouth in the palato-maxillary foramen. These foramina transmit the descending palatine, or palato-maxillary nerve of the second division of the fifth pair, and its corresponding artery, from the internal maxillary.

Lastly, the *spheno-maxillary fissures*, or *foramina lacera orbitalia inferiora*, are situated between the orbitar processes of the sphenoid and superior maxillary bones, and are bounded behind by the palate bones: they extend along the back and under part of the orbits, communicate with the spheno-maxillary fossa, and allow the passage of the infra-orbitar nerve, and a branch of the internal maxillary artery: but it may also be observed, that the carotid canal is in part common to the sphenoid and temporal bones.

Connexion.—In the description of the attachment of this bone to the other bones of the skull, it is to be considered as placed in its natural position, and beginning from before on the middle line, passing outwards, then backwards, and lastly to its inferior surface. The os sphenoides is connected by the rough edge of the anterior and middle part of the body, which is termed the ethmoidal spine, with the ethmoid bone; by the alæ minores, and anterior edge of the alæ majores with the frontal bone; and by the rough triangular surface on the external and superior edge of the alæ majores with the parietal bones. The ridge on the fore part of the alæ majores, separating the orbitar from the temporal processes, and termed the malar process, connects the sphenoid with the malar bone; by the whole of the outer serrated edges of the alæ majores, extending as far backwards as to the spinous processes, it is joined to the squamous and petrous portions of the temporal bones: and lastly by the posterior part of its body to the occipital bone it is joined by epiphysis in early periods of life. The anterior surfaces of the pterygoid processes are attached to the palate bone; and sometimes also immediately below this attachment these processes are connected to the superior maxillary bone: lastly, the azygos process of the sphenoid bone is joined to the vomer.

Attachment of Muscles.—The following muscles are attached to the os sphenoides, all of them having their origin from it, viz.:—*all* the muscles of the eye, excepting the inferior oblique:—m. levatores palpebrarum superiorum, levatores, depressores, abductores, adductores et obliqui superiores oculorum, temporales, pterygoidei externi and interni, buccinatores, externi mallei, constrictor pharyngis superior, and tensores palati.

Use.—The use of this bone, in common with the other bones which assist in forming the cranium, is to support the brain; but it also particularly serves to strengthen the skull by the manner in which it extends across the base and is clamped with the temporal bones, preventing the separation of these bones from a blow on the vertex. Through its numerous foramina it allows of the passage of important nerves from the brain. It also assists in forming the bony orbit, the nose, and the upper and lateral boundary of the pharynx.

Practical Points.

This bone cannot be fractured from the immediate application of any external violence upon it, being so deeply seated; but it is liable to fracture from blows upon the vertex of the skull, which accident is indicated by bleeding from the ears, and sometimes from the nose, in consequence of the rupture of some of the vessels of the mucous membrane lining the sphenoidal sinuses, which open into the nose. It is, also, liable to be affected by diseases incident to the mucous membrane, as polypi, etc.

The Os Ethmoides

Is placed in the anterior, inferior, and middle line of the base of the skull, between the two orbitar plates of the frontal bone.

It is of a cuboidal figure, cellular in its structure, and has derived its name from being penetrated by numerous holes for the transmission of the first pair of nerves. It presents the following parts for description, viz.: its *horizontal plate,* its *ascending, descending,* and *lateral laminæ,* its *cells* and *turbinated bones.*

The *horizontal plate,* which forms the body of the bone, is cribriform, has its long axis from before to behind, and offers a superior and an inferior surface, an anterior, posterior, and two lateral edges. From the superior surface, situated anteriorly, there ascends a triangular lamina of bone, named the *crista galli*, which is compact in its structure, and terminates in a point or apex: its base is attached to the horizontal plate of the bone, while the apex gives attachment to the falx major. The fore part of the crista, which is vertical, is grooved, and by its junction at this point with the frontal bone usually completes the foramen cœeum. From the under surface of the cribriform or horizontal plate, there passes downwards the *nasal lamella*, having a base in common with the crista galli: it usually does not pass downwards vertically into the nose, but with an obliquity, so as to divide that cavity unequally. This nasal lamella is not of so compact a structure as the crista galli; but its edges are thicker than the rest of the bone, for its attachment with other bones and cartilages of the nose. The lateral edges of the cribriform plate give attachment to numerous cells of an unequal size, which open into each other and into the cavity of the nose: they are termed the *ethmoidal cells*, and are divided into the anterior and posterior. The anterior are covered by the ossa unguis, and the posterior by thin laminæ which form a part of the bony orbit, from which circumstance they are named the *orbitar processes*. On the upper edges of these processes two notches may be observed, which serve for the completion of the two internal orbitar foramina by their junction with the frontal bone: their circumference is rough for their attachment to other bones forming the orbit. Below, and to the inner side of the orbitar plates, are found two thin processes of bone, being irregular in their form, but twisted upon themselves so as to produce a convex internal surface towards the nasal lamella, and a concave outer one enlarging the cavity of the nose: the upper edge only is attached to the ethmoid bone, the lower hanging pendulous into the nose. These two bones are termed the *ossa turbinata*, or *spongiosa*, but are to be considered as processes of the ethmoid bone. Consequently, all those parts of the ethmoid bone communicating with the cavity of the nose, including the cells, are covered by a continuation of the pituitary membrane.

Connexion.—The anterior and lateral edges of the cribriform plate of the ethmoid bone, are connected with the os frontis by interposition between its orbitar plates, forming the ethmoidal suture; which suture is completed at the posterior border of the horizontal plate by its junction with the sphenoid bone. The under edge of the orbitar plates is connected with the orbitar processes of the superior maxillary bones; anterior to which connexion is that of the ossa unguis, covering in the anterior ethmoidal cells: while behind the junction of the ethmoid bone with the superior maxillary, a small portion of the palate bone becomes attached within the orbit. Lastly, the nasal plate is attached to the vomer inferiorly, and anteriorly to the nasal bones.

Use.—The ethmoid bone serves the purpose of supporting the anterior lobes of the brain, and of protecting and transmitting the first pair or olfactory nerves: it assists also in forming the orbit, the bony cavity and septum of the nose, and enlarges the surface for the attachment of the pituitary membrane.

This bone has no muscles connected with it.

Practical Points.

The ethmoid bone is particularly liable to exfoliation from its peculiar texture, and is frequently involved in the diseases incident to the lining membrane of the nose: hence, in ozœna and syphilis, the destruction of parts of this bone often follows. Polypi being usually fixed to the superior turbinated bones, a knowledge of their delicate structure should render the surgeon particularly careful in their extraction. Severe and extensive fracture of the ossa nasi does not offer so favourable a prognosis as might be supposed, when we consider the injury the ethmoid bone is liable to sustain, and its proximity to the brain. Malignant tumours, situated within the ethmoidal cells, will equally affect the eye and nose.

The Bones of the Face

Form the under and fore part of the head, comprising all that portion below the os frontis, and anterior to the pterygoid processes of the sphenoid bone. In conjunction, also, they form the upper and the lower jaws—the former being immoveably fixed to the cranium, while the latter, forming the principal organ of mastication, is attached by a moveable articulation to the temporal bones.

Although the whole of that part of the face above the inferior maxillary bone may be considered as constituting the upper jaw, still we shall find it composed of numerous separable bones, named from the different parts which they assist in forming: but, as a whole, they are so firmly connected as to be individually incapable of exercising any independent motion.

The bones of the face consist of the *ossa nasi*, *ossa unguis* or *lacrymalia*, *ossa malarum*, *ossa maxillaria superiora*, *ossa palati*, *ossa spongiosa inferiora*, and *os vomer*. These are the bones which constitute the upper jaw, which at the adult period of life is furnished with sixteen teeth; while the lower jaw consists of a single bone, the *os maxillare inferius*, with a like number of teeth.

I shall now proceed to describe each of these bones separately.

The Ossa Nasi

Are situated immediately under the nasal process of the os frontis, from which they project downwards and forwards, forming the dorsum of the nose: they are each of an oblong form, having their long axis from above to below, and present two surfaces and four edges. Their surfaces are an *external* convex one, to give strength and form to the nose; an *internal* concave one, to enlarge the cavity. Their *superior edges* are rough, thick and compact, producing a very firm connexion with the nasal process of the frontal bone; and forming, by this union, a part of the transverse suture. The *anterior edges* are each slightly roughened, for attachment with its fellow. The *posterior edges* are peculiar, being hollowed above to *receive* the nasal process of the superior maxillary bone, and thin below, where they *overlap* the superior maxillary; thus giving great strength to the articulation. These bones become wider as they descend towards their *inferior edges,* which are spreading, and very irregular, to give attachment to the cartilages of the nose. The two ossa nasi, when connected, form an arch, filling up the space between the nasal processes of the superior maxillary bones; thus constituting the fore part of the nasal cavity. From their junction internally proceeds a small spine, through the medium of which they become connected with the ethmoid bone.

Connexion.—These bones are connected, above, to the os frontis; anteriorly, to each other, and to the nasal plate of the ethmoid; posteriorly, to the superior maxillary bones; and internally, to the septum narium.

Attachment of Muscles.—Those attached to the nasal bones are the occipito-frontalis, and compressor naris.

Practical Remarks.

The manner in which these bones are articulated, as well as their arched form, renders them but little liable to fracture, notwithstanding their exposed position, and the little protection afforded them by soft parts. When, however, they are broken, the diagnosis is sufficiently obvious from the deformity produced. The prognosis is favourable, unless the accident be complicated with injury to some more important parts. Compound fractures are usually followed by exfoliation of bone, rendering the cure tedious.

The Ossa Lacrymalia,

Or, *ossa unguis,* have been so named from their use and form: they are situated on the inner and fore part of the orbit, and present an *external* and *internal surface,* and *four edges.* The *external surface* is divided by a thin ridge into two portions; the posterior of which is plain, forming a part of the orbit, and may be called therefore the *orbitar process.* The anterior portion is hollowed, and assists in forming a cavity for lodging the lacrymal sac and ductus ad nasum. The internal surface is irregular, and covers the anterior ethmoidal cells.

Connexion.—The *superior edge* connects them with the os frontis, forming a part of the transverse suture; the *posterior edge* with the orbitar process of the ethmoid bone; the *anterior edge* with the nasal process of the superior maxillary; and the *inferior edge* with the orbitar process of the same bone. Within the nose these bones are slightly connected to the inferior turbinated bone; forming there, with the assistance of the superior maxillary bone, the ductus ad nasum.

There are no *muscles* attached to them.

Practical Points.

The texture as well as the situation of this bone is important to the surgeon, especially in reference to fistula lachrymalis. In this disease, the delicate structure of the bone suggests the propriety of an early opening, to evacuate the matter; and requires caution, in the performance of the operation for its radical cure.

The use of this bone is sufficiently implied by its description.

The Ossa Malarum

Are the square prominent bones which form the cheeks: their external surface is convex and smooth—their internal surface is concave. These bones, anteriorly, form the cheeks; posteriorly, they join the temporal bones; and, superiorly, enter into the composition of the orbit.

The form of these bones is an irregular square, and they may be divided into three distinct parts or surfaces, which will point out both their position and use. They present a superior or orbital surface, an external or facial surface, a posterior or temporal surface; but each of these parts is subdivided by processes which are to be described.

The superior or orbital portion of the bone is semilunar in its form, and terminates by two cornua: the superior one is rough, to be connected with the frontal bone, just at the outer and superior part of the orbit, and is termed the *superior orbitar process:* the inferior cornu is also roughened, to form a similar junction with the superior maxillary bone, and is termed the *inferior orbitar process ;* by this union forming the anterior boundary of the spheno-maxillary fissure. The concave line, running from the one cornu to the other, forms the external brim to the orbit; from which passes backward a triangular concave process of bone, forming a part of the orbit, and denominated the *internal orbitar process:* this is connected above with the orbitar process of the frontal bone, and below with the sphenoid.

The *external* or *facial surface* of the bone is convex and smooth, forming an anterior right angle, and a posterior acute one. The anterior angle is rough, for its connexion with the malar process of the superior maxillary bone; while the posterior one forms the zygomatic process, and connects it with the temporal bone: completing, by their junction, the zygomatic arch. The inferior edge of the facial surface is straight and slightly rough, for the attachment of the masseter muscle.

The *posterior* or *temporal surface* is concave, and smooth above, for the passage of the temporal muscle; and somewhat rough below, for the origin of the masseter.

There is only one complete foramen in this bone, called the malar: it passes from the orbital through to the facial surface, and transmits a branch of the second division of the fifth pair of nerves, together with a branch of the internal maxillary artery. This bone likewise forms the anterior extremity of the spheno-maxillary fissure.

Connexion.—The malar bone is connected, by its superior orbitar process, to the frontal bone, forming a part of the transverse suture; by its internal orbitar process, to the sphenoid bone; by its inferior orbitar process, and anterior angle, to the superior maxillary bone; and by its posterior acute angle, to the temporal bone.

The Attachment of Muscles to the malar bones are the zygomatici and masseter: the orbicularis palpebrarum in front, and the temporal muscle behind, cover portions of these bones without being connected to them.

Practical Remarks.

From the exposed situation of these bones they are liable to fracture, although from their arched form the force to produce the accident is necessarily so considerable as usually to effect comminution of bone and laceration of the soft parts, rendering the fracture compound. In this case the surgeon should carefully remove all the detached portions of bone, and any extraneous body which may have been introduced, as deep fistulous abscesses are liable to form in the cavities behind these bones. Inflammation of the eye frequently follows these accidents, from the fracture extending into the orbit. It is behind the zygomatic arch, formed by this bone and the temporal, that the condyloid process of the lower jaw is thrown in dislocation.

The Ossa Maxillaria Superiora.

Of the six pairs of bones which enter into the composition of the upper jaw these are the largest, and derive, on that account, their specific name. The form of these bones is extremely irregular, offering a number of processes and depressions, which enter into the composition of the cavities of the orbits, nose and mouth.

Each maxillary bone is divided into a body and seven processes.

The *body* occupies the central portion of the bone, and is hollowed out, forming the *antrum highmorianum,* which has a natural opening into the middle chamber of the nose, and is lined by a continuation of the pituitary membrane. The anterior and external surface of the body presents a *concavity,* which is situated immediately beneath the foramen infra-orbitale, giving origin to the m. levator anguli oris. The posterior extremity of the body is rounded, and forms the *tuberosity* of this bone, which is rough for the attachment of the pterygoid process of the palate bone, and origin of the m. pterygoideus externus. On the inner side of the tuberosity is a *groove,* forming part of the *palato-maxillary foramen,* which is completed by the palate bone. It leads from the spheno-palatine *canal* into the roof of the mouth, and transmits the palatine nerve and artery; the lower part of the body forms an irregularly curved line, divided into compartments for the insertion of eight teeth, which portion of the bone is called the alveolar process. The upper part of the body presents a plain, somewhat concave surface, which forms the lower part of the orbit, and is called the *orbitar process;* upon this process may be observed posteriorly a groove which soon becomes a canal, and terminates as the *infra-orbitar foramen* upon the body of the bone, through which passes a branch of the second division of the fifth pair of nerves. The form of the orbitar process is triangular, its inner edge being rough for its attachment to the lacrymal, ethmoid, and palate bones within the orbit, while its outer margin forms a part of the *spheno-maxillary fissure.* Anteriorly, and on the inner side of the orbitar process, a portion of bone passing upwards to be connected with the os frontis; and forming the lateral parts of the nose, is called the *nasal process.* It presents a base, attaching it to the body of the maxillary bone; an apex roughened, to connect it with the frontal bone; an external convex surface, and an internal surface, concave, to enlarge the nasal cavity. Upon this cavity we observe a *ridge* of bone, running from before to behind, to lodge the inferior turbinated bone; an anterior thin edge, to connect it with the nasal bones; and a posterior edge, forming a deep *sulcus,* completed into the ductus ad nasum by the lacrymal and inferior turbinated bones. Upon the outer side of the orbitar process is seen a rough triangular projection, termed the *malar process,* from its giving connexion to that bone. Immediately behind this process is seen a depression, for the passage of the temporal muscle. Projecting horizontally inwards, from the body of the bone, is the *palatine process.* It is concave both above and below, to enlarge the cavities of the nose and mouth; rough behind, for its attachment to the palate bone, and rough on its inner edge, to join with its fellow. By this junction a projecting *spine* is formed into the nose, called the *nasal spine,* and which extends sufficiently forwards to produce the internal boundary of a sulcus, between it and the root of the nasal process. This sulcus, in the skeleton, forms the anterior opening to the nares. On the anterior part of the rough surface, which connects the palatine process with its fellow, is found a groove on each bone, which form, by their junction, a canal, common to the two bones below, but terminating, above, in a foramen proper to each maxillary bone. This canal is called the *ductus incisivus :* establishing a communication between the nostrils and the mouth.

The foramina proper to this bone, are:—the *foramen infra-orbitale,* forming the anterior opening of the infra-orbitar canal; and the *foramen incisivum,* passing from the nose, and joining with its fellow, to form the ductus incisivus. The common foramina are, the *palato-maxillary,* the *spheno-maxillary fissure,* and the *ductus incisivus.* The names of the two former express their construction; the latter is formed by the junction of the palatine processes of the two bones. The maxillary, with the assistance of the lachrymal and inferior turbinated bones, form the fossa for lodging the lachrymal sac and the ductus ad nasum.

Connexion.—The superior maxillary bone is connected, by its malar process and orbitar process, to the malar bone; by the anterior edge of the nasal process, to the nasal bone; by its upper extremity to the os frontis, by the posterior edge of the same process, and by the adjoining part of the orbitar plate, to the lachrymal bone, behind which the orbitar plate joins the ethmoid. The back part of the orbitar process, together with the tuberosity and the posterior edge of the palatine process, is connected to the palatine bone. The internal edge of the palatine process joins its fellow; the inferior turbinated bone is attached to the ridge running across the internal surface of the nasal process: and lastly, the vomer is connected to the nasal spine, produced by the union of the two ossa maxillaria.

Attachment of Muscles.—The muscles attached to this bone are the masseter, the constrictor pharyngis superior, the pterygoideus externus, the buccinator, the levator anguli oris, the levator et depressor labii superioris, alæque nasi, the orbicularis palpebrarum, the obliquus oculi inferior, and compressor naris.

This bone forms the greatest part of the floor and lateral walls of the nose. It also forms the whole of the antrum highmorianum communicating with the nasal cavity, and enters into the composition of the orbit and the lachrymal apparatus. It forms the larger portion of the bony palate, and, by receiving the upper teeth, becomes a part of the organ for mastication.

The Practical Points

Connected with the superior maxillary bones are numerous in proportion to the many offices these bones assist in performing, but more particularly as connected with the diseases of the mucous membrane lining the antrum highmorianum; which cavity being in such close connexion with the eye, forming its upper boundary, the nose having an opening into it on the inner side, and the mouth below, each of these parts become soon secondarily affected: therefore, in cases of suppuration, the matter should be very early evacuated. This is effected by extracting the last molar tooth but one, the fang of which usually penetrates the cavity; or, should it not do so, a pointed instrument should be pushed into it, and the pus let out. The opening should be made sufficiently large, to admit readily of the cavity being injected; and if the drawing of one tooth be not sufficient to effect this, two or even more should be extracted. Polypi frequently form in the antrum; and in aggravated cases the form of the face is sometimes most hideously altered, and the function of the neighbouring organs destroyed. This happens when the polypus is of a malignant character; therefore as soon as the surgeon ascertains such a tendency, a trephine should be applied on the body of the maxillary bone, and the disease removed. It should be held in mind that diseased teeth are frequently the exciting cause of diseased antrum, and that the removal of a tooth at an early period might prevent all the baneful effects described.

The Ossa Palati

Are situated in the palate, immediately behind the palatine processes of the superior maxillary bones, and they together form the bony palate: they also extend, so as to form a part of the cavity of the nose and orbit. They are extremely irregular in their form, but are divided into four distinct parts:—their *body* or *palatine process*, their *nasal process*, their *orbitar process*, and lastly, their *pterygoid process:* each part by its name implying its use and its situation.

The *body*, or *palatine process*, is the most compact part of the bone. It forms an horizontal square plate, which presents a *superior* surface, concave, to enlarge the cavity of the nose; an *inferior* concave surface, to form the posterior part of the roof of the mouth; an *anterior* serrated edge, which connects this part of the palate bone to the superior maxillary bone; a *posterior*, smooth, semilunar edge, which gives attachment to the muscles of the soft palate; an *inner* straight edge, elevated and rough, to be connected with its fellow, their junction forming the *nasal spine* and part of the bony septum of the nose: and lastly, an *external* edge, which connects this portion of the palate bone to its

Nasal or ascending process.—This process is a thin lamina of bone rising perpendicularly upward from the outer edge of the palatine process, and passing into the nose on the inner side of the tuberosity of the superior maxillary bone. The nasal plate presents an internal surface which forms the outer bony boundary to the nose, and has placed upon it a thin spine passing from before to behind, which lodges the inferior turbinated bone. Its *external* surface is rough, to attach it to the maxillary bone, and presents a deep groove passing from above to below, leading into the roof of the mouth, and forming the *palato-maxillary foramen.* The upper half of the nasal process covers the posterior part of the antrum highmorianum, and diminishes the opening of this cavity into the middle chamber of the nose. From the anterior upper edge of the nasal plate the third process of the palate bone presents itself, viz., the *orbitar process.* This is attached to the nasal lamella by a kind of neck, giving the appearance of a notch when the palate bone is separated from the other bones of the head, but forming by its junction with the sphenoid bone a foramen, which leads into the nose, and is termed the *spheno-palatine or lateral nasal foramen.* The *orbitar process* is of a triangular shape, being wedged in at the back part of the orbit between the orbitar processes of the superior maxillary ethmoid and sphenoid bones. The posterior surface of this process of the palate bone is hollow and cellular, covering, and indeed enlarging the posterior ethmoidal cells.

The last process to be described is the *pterygoid process*, which passes outwards, backwards, and slightly downwards, from the posterior point of attachment of the horizontal palatine with the ascending nasal process. It is of a triangular form, and the apex of the triangle is admitted between the anterior part of the pterygoid processes of the sphenoid and the tuberosity of the maxillary bones. The posterior surface of this process produces two grooves, which are occupied by corresponding eminences on the anterior part of the pterygoid processes.

This bone possesses no *proper* foramina, and the two which are common to it, and to the sphenoid and maxillary bones, have been already described.

Connexion.—It is connected to its fellow, by the inner edge of the palatine plate; to the superior maxillary bone, by the anterior edge of the same plate, and by its ascending nasal and orbitar processes. The orbitar process also connects it with the ethmoid bone, by the posterior edge of its nasal plate, as well as by its pterygoid process, to the sphenoid bone: the ridge on the inner surface of the nasal plate connects it to the inferior turbinated bone: and lastly, by its nasal spine, produced by the union of the two palatine processes, it is joined to the vomer.

The *Muscles* attached to the ossa palati are the m. pterygoidei externi and interni, buccinatores, constrictor pharyngis superior, circumflexus palati, and azygos uvulæ.

Use.—Assists in forming the mouth, nose and orbit, and it also completes the posterior ethmoidal cells.

Practical Remarks.

The palatine plates of these bones, as well as the superior maxillary bones, are sometimes unnaturally separated from each other in malformation. They are liable to exfoliation from syphilitic affections of the soft palate; and their delicate structure should also be remembered in the removal of polypi.

The Os Vomer

Is an irregular square bone situated in the median line of the face, and forms the principal part of the bony septum of the nose. It presents *four edges* taking an oblique direction from behind to before, and two surfaces.

The *superior* edge, the thickest, forms a deep groove to receive the azygos process of the sphenoid bone, offering the best example of articulation by schindylesis: the *inferior* edge is thinner and longer, and is connected to the nasal spines of the superior maxillary and palate bones. Its *anterior* edge forms a deep sulcus, to be joined posteriorly to the nasal lamella of the ethmoid bone, and anteriorly with the cartilage, completing the septum of the nose. The *posterior* edge is somewhat rounded, turned towards the pharynx, and separates the posterior openings of the two nasal cavities. The surfaces of this bone form the inner boundary of the nose.

Connexion.—The bone is thus connected above, with the sphenoid; below, with the superior maxillary and palate bones; and, before, with the ethmoid. Its posterior edge divides the bony cavity of the nose; and thus forms a septum to the nares, as they open into the pharynx.

The Vomer sometimes has an opening through from one nostril to the other.

The Ossa Turbinata Inferiora.

These bones offer a very considerable addition to the cavity of the nose, without increasing the size of that organ, by affording a greater extent of surface for the attachment of the pituitary membrane. They are very similar in shape to the superior turbinated bones, and have their convexities turned inwards. From the superior edge extend two processes; the anterior of which passes upwards, to the lacrymal plate of the os unguis, and completes the ductus ad nasum. The posterior process is larger, becomes curved downwards, and is attached to the lower edge of the opening of the maxillary antrum, which it thus partly closes. The bone becomes narrower towards each extremity, but terminates in a much more acute point behind than before. The turbinated bone is connected by its superior edge only: the anterior part of which is attached to the ridge on the inner surface of the nasal process of the superior maxillary bone, and to the unguis: the posterior part is fixed to a similar ridge on the nasal plate of the palate bone. The rest of the bone is unattached, and projects into the nasal cavity.

The *use* of this bone is, to form an extended surface for the attachment of the lining membrane of the nose, and to assist in closing the entrance of the antrum highmorianum. It also assists in forming the ductus ad nasum, and divides the middle from the inferior chambers of the nose.

Practical Remarks.

The principal pathological facts connected with this bone refer to its texture, which is so delicate, that, in disease, it readily exfoliates. In the removal, also, of polypi, or any extraneous bodies from the nasal cavities, great caution must be had not to injure it. In fistula lachrymalis, as a palliative remedy, a small probe is sometimes passed up the ductus ad nasum, which opens immediately behind this bone into the lower chamber of the nose: its situation, therefore, should be carefully examined.

The Os Maxillare Inferius

Is a single moveable bone, situated immediately below the upper jaw, forming the lower boundary to the face. It is somewhat of the figure of a horse's shoe, or the Greek letter υ; and to facilitate its description, it may be divided into its *body*, or chin; its *horizontal plate;* and its *ascending ramus*, terminating in the *condyloid* and *coronoid processes*. Both the external and internal surface of this bone offer many lines and irregularities, for the attachment of the numerous muscles, necessary to the various functions which this bone has to perform in mastication, speech, deglutition, etc., etc.

The *body* of the bone, or *chin*, forms the most anterior and central part of the bone, and is bounded on either side by the anterior maxillary, or mental foramen, on its external convex surface; and by the termination of two oblique lines, on its internal concave surface. The middle line, joining the two symmetrical sides of the jaw-bone, is termed the *symphysis;* which, at the lower part, is formed into a rounded protuberance, to which the term *chin* is more especially applied; and from which a short line extends laterally outwards and upwards on each side, giving attachment to the muscles which depress the lower lip. The muscles which raise the lip also mark this portion of the bone, at the root of the sockets of the two outer dentes incisivi. The internal surface of the body of the lower jaw in the middle line, is marked by a process of bone, which is termed the *spine*. It is sometimes bifid; and, at others, divided into three or more small projections. They give attachment to the frænum of the tongue, above; to the m. genio-hyoglossi, in the middle; and the genio-hyoidei, below: and on each side, a small rough depression marks the attachment of the m. digastrici. The upper portion of the body of the bone forms a part of the *alveolar process*, which contains the sockets for eight teeth. This process, however, extends backwards, along the horizontal plate of the jaw, as far as to the root of the coronoid process.

The *horizontal plate* of the lower jaw is that surface bounded before by the anterior maxillary foramen and body of the bone, and behind by what is called the *angle* of the lower jaw: an angle formed by the junction of the horizontal with the ascending plate of the same bone. The external surface of this horizontal plate presents a *ridge*, commencing from its base, which, running obliquely upwards and backwards, ascends a considerable way above the level of the plate. It terminates in a peak, which forms the anterior boundary of what is called the coronoid process. This oblique ridge may be said to divide, unequally, the external surface of the horizontal plate into an anterior and posterior portion. In describing the former, we distinguish the upper edge, which constitutes a part of the alveolar process. In the latter, we notice its base, proceeding backwards to form, by its junction with the ascending plate, the angle: while passing for wards, continuously with the lower edge of the anterior portion of the horizontal plate and body of the jaw, it completes the proper *base* of the bone. The internal surface of the horizontal plate has a very close resemblance to the external one; being, like it, divided into an anterior and posterior portion by a similar oblique ridge, but which proceeds to the posterior maxillary foramen instead of to the coronoid process, as the external ridge does. This ridge gives origin to the muscle mylo-hyoideus.

The *ascending plate* divides itself into two processes superiorly, and presents a semilunar edge between the two, which has its concavity turned upwards: inferiorly, it is bounded by the horizontal plate and angle of the jaw: posteriorly, it forms an obtuse edge, which passes upwards, and terminates by producing the neck and condyloid process. The anterior edge is sharp, and forms the coronoid process: it presents an external surface, roughened for the attachment of the masseter muscle; and an internal one, which gives insertion to the pterygoideus internus.

The *coronoid process* extends perpendicularly upwards, becoming pointed towards its extremity, which, when the jaws are closed, is received behind the zygomatic arch. Its posterior edge is thin, its anterior rather more rounded: it is flattened laterally. This process is completely surrounded by the insertion of the temporal muscle, which also extends along its anterior edge as far as the horizontal plate of the bone.

The *condyloid process* passes upwards and a little backwards, and is attached to the ascending plate by a contracted portion of bone called the *cervix;* on the inner side of which there is a depression, for the insertion of the pterygoideus externus muscle. The condyle itself, or extremity of the process, is convex and of an oval shape, having its greatest length from side to side. It is, also, more covered anteriorly with cartilage than posteriorly, so as to be capable of motion upon the articulatory surface, at the root of the zygomatic process of the temporal bone. It is received into the fossa condyloidea, or anterior depression of the glenoid cavity in the temporal bone, to which it is connected by a moveable articulation.

The foramina of this bone consist of two pairs, viz.:—the posterior and anterior maxillary.

The *posterior maxillary foramina* are situated on the inner surface of the ascending plates, and allow the entrance of the dental nerves and arteries. They are protected by a projecting process of bone, which gives attachment to the internal temporo-maxillary ligament.

The *anterior maxillary or mental foramina*, are situated on the external surface of the bone, at the junction of the body with the horizontal plates: they allow the exit of the same nerves and blood-vessels mentioned above. These foramina are connected on each side by an intervening canal, which also extends as far as the symphysis. Small openings are found, leading from it to the sockets of the teeth. This canal is termed the *canalis mentalis.*

The only bones with which the lower jaw is connected are the temporal on each side, as already described.

The *muscles* attached to this bone are the m. temporales masseteres, pterygoidei interni et externi, depressores labii inferioris, depressores anguli oris, levatores labii inferioris, buccinatores, digastrici, mylo-hyoidei, genio-hyoidei, genio-hyoglossi, and constrictores pharyngis superiores. The platysma myoides also passes over the bone on each side, and is partly attached to it.

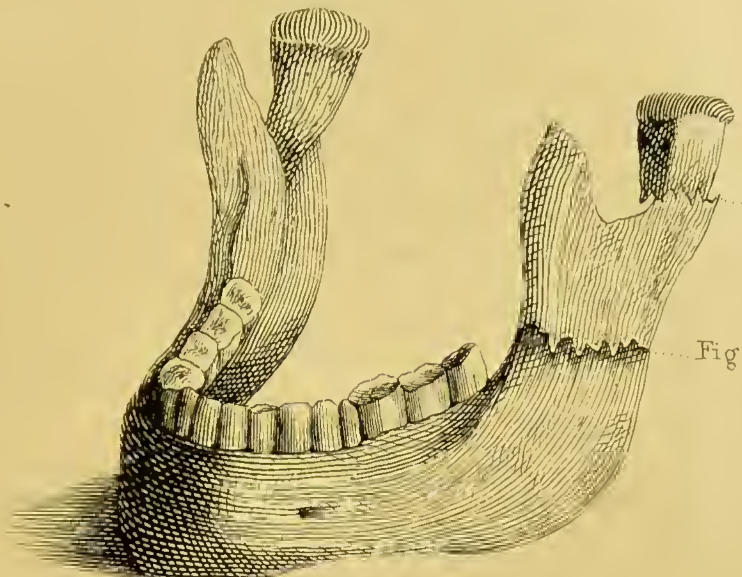
Use.—The inferior maxillary bone contains the sixteen lower teeth, and forms the moveable organ for mastication. It also forms the lower boundaries of the mouth, and gives origin to several of the muscles of the tongue, larynx, and pharynx: thus assisting in the functions of speech, swallowing, etc.

Practical Remarks.

The numerous functions in which this bone has an important share, necessarily render its diseases of great pathological interest. From its moveable articulation with the temporal bones, it is liable to the diseases and accidents incident to joints. The formation, growth and decay of the teeth, subject this bone to diseases, which have, in some cases, rendered the extirpation of one half of the bone necessary. *(Vide Dublin Hospital Reports, Vol. III.)* This bone is more frequently fractured than any other bone of the face: the accident is generally produced by very severe blows, and may take place in any part of its surface; but each part presents its peculiarity of displacement, from the action of muscles upon it. For instance: when the condyle is detached by fracture through the cervix, the detached portion is drawn forwards and inwards, by the action of the peterygoideus externus muscle: this portion of the bone being so small as to prevent any force being applied to replace it, it is necessary to bring the whole of the bone into the same direction which the fractured portion has assumed, to produce union. *(Vide Fig. 1. Plate I.)* In fractures through the ascending process, but little displacement ensues, in consequence of the extent of attachment of the pterygoideus internus on the inner side, and of the masseter muscle on the outer. *(Vide Fig. 2. Plate I.)* Fractures through the horizontal plate:—In this accident, the fractured portion attached to the chin, is drawn downwards and backwards by the muscles connecting the lower jaw with the os hyoides; and if, in this fracture, a portion of the bone be detached, the deformity is greater, from its being more completely under the influence of these muscles. *(Vide Fig. 3. Plate I.)* In such accidents the fractured portions are to be kept in apposition, by connecting a tooth of each fractured portion with wire, and by keeping the mouth closed; making the upper jaw thus act as a splint. This bone is liable to exostosis; which sometimes acquires a size so considerable, as to interfere with the functions of the bone, and to render its removal necessary. Exfoliation of this bone frequently occurs, from the irritation produced by diseased teeth.

The Os Hyoides,

So named from its resemblance to the Greek letter υ. It is placed horizontally on the fore part of the neck, between the base of the tongue and larynx, and opposite to the space between the third and fourth cervical vertebræ. This bone forms no part of the skeleton, being merely fixed to the



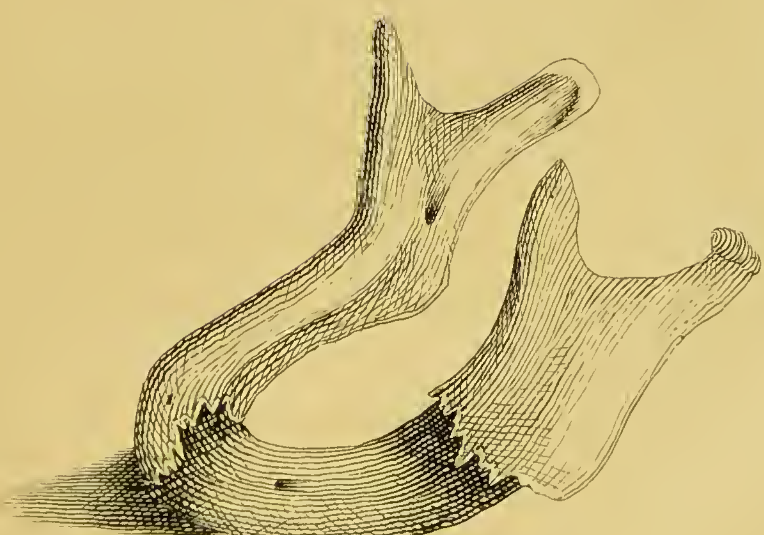


Fig. 3.

J. Basire lithog

trunk by soft parts. The os hyoides is divided into its *body*, *cornua*, and *appendices*; all of which are moveable upon one another until advanced periods of life.

The *body* is the central and largest part of the bone, marked upon its external surface by the numerous attachments of muscles, connecting it, above, with the lower jaw and the tongue; below, with the larynx and trunk; posteriorly it is concave; and, through the medium of membrane and fat, it is connected with the epiglottis.

The *cornua* are connected with the extremities of the body, and pass backwards and slightly upwards towards the styloid processes of the temporal bones, to which they are joined by ligament; superiorly, they are connected with the tongue by the hyoglossi muscles; and, inferiorly, by the broad and round ligaments, with the superior cornua and upper edge of the thyroid cartilage.

The *appendices* are two little projections of bone, which pass upwards and outwards from the junction of the base with the cornua, and assist in giving attachment to some of the muscles connecting this bone with the tongue and jaw.

Muscles attached to the os hyoides, above, are the m. digastrici, mylo-hyoidei, genio-hyoidei, genio-hyoglossi, hyo-glossi, and stylo-glossi: below, sterno-hyoidei, omo-hyoidei, thyro-hyoidei: laterally, the constrictor pharyngis medius.

Use.—This bone, under different circumstances, forms a fixed point for the action of muscles of the tongue, jaw, larynx, and pharynx.

Practical Remarks.

The extent of motion of this bone renders it but little liable to fracture. Where the throat has been cut, the prognosis is more favourable *(cæteris paribus)* when the incision is above than when it is below this bone. It should be remembered that the cornua are situated between two important arteries,—the lingual above, and the superior thyroideal below.

The Base of the Skull.

Having described separately each bone which enters into the composition of the head and face, and also their respective foramina, it is now my intention more particularly to point out the direction and use of these foramina, with the cavities and fissures into which they open, or to which they lead. The internal surface of the base of the skull, from which all the foramina pass, is divided into three regions;—an anterior, a middle, and a posterior,—to support the corresponding parts of the brain. Of these divisions the anterior is the highest, the middle lower, and the posterior the lowest.

The *anterior* includes all that part of the base situated before the transverse spinous processes of the sphenoid bone; and in this division the following processes, foramina, and depressions, are observed. First, two convexities constituting a large part of the floor of this division, formed by the orbitar processes of the frontal bone; between which convexities—and completing the floor—is situated the horizontal or cribriform plate of the ethmoid bone. From the surface of this cribriform plate arises the crista galli, from which, passing upwards, we see the commencement of the frontal spine, soon bifurcating to form a groove for the superior longitudinal sinus; at the point of junction of the spine with the crista galli, is placed the foramen cœcum: all these parts give attachment to the falx major. On each side of the crista galli are the foramina cribrosa, leading into the superior chamber of the nose, for the transmission of the first pair of nerves, which are here protected from the weight of the brain by grooves formed on its under surface. The depressions in this division are produced by the inequalities on the anterior lobes of the cerebrum.

The *middle region* includes that space bounded, before, by the alæ minores and by the processus olivaris of the sphenoid bone; behind, by the posterior clinoid processes and superior ridges of the petrous portions of the temporal bones;

and, laterally, by the squamous portions of the temporal and alæ majores of the sphenoid bones. Several processes, which have already been described as belonging to the internal surface of these bones, are here observable. This division receives the middle lobes of the cerebrum, lodged in two deep concavities, situated on each side of the sella turcica. As the *foramina* of this division transmit important nerves, it is of consequence to describe them more particularly, while taking this collective view of the base of the skull. In the first place we notice the *foramina optica*, situated at the roots of the anterior clinoid processes, and leading into the inner and back part of the orbit, directly above the foramina lacera orbitalia superiora. They transmit the optic nerves, and the ophthalmic arteries, which enter the orbit above, and to the inner side of the several nerves which pass through the lacerated foramina. Below, and extending considerably outwards, are found the *foramina lacera orbitalia superiora*, which enter the orbit in a direction forwards and inwards, and transmit the third, fourth, first division of the fifth, and sixth pair of nerves; all of which are for the purpose of giving motion and sensation to the eye-ball and its appendages. The ophthalmic veins also pass backwards through these foramina, to empty themselves into the cavernous sinuses. The next pair of foramina, which are only separated from the last described by a very small septum of bone, are the *foramina rotunda*. They proceed downwards and forwards, and terminate in the spheno-maxillary fossa,—a cavity which is bounded, before, by the tuberosity of the superior maxillary bone and orbit; on the inner side, by the spheno-palatine foramen leading into the nose; below, by the commencement of the palato-maxillary canal; behind, by the roots of the pterygoid processes and the pterygoid foramen: and, externally, by a large space between it and the zygomatic arch. The foramina rotunda allow the passage of the second division of the fifth pair of nerves, the distribution of the branches of which is easily understood, by referring to the openings just described as leading out of the spheno-maxillary fossa. Behind these, and situated to their outer side, are found the *foramina ovalia,* which open on the external base of the skull, posterior to the pterygoid processes of the sphenoid bone, and to the inner side of the glenoid cavity, immediately in front of a groove which lodges the eustachian tube: they transmit the third division of the fifth pair of nerves, destined to supply the tongue, lower jaw, and the muscles of mastication. The *foramina spinosa,* at the extreme points of the spinous processes of the sphenoid bone, open externally between the foramina ovalia and the styloid process of that bone. They allow of the passage of the middle meningeal artery of the dura mater. At the extremity of the petrous portion of the temporal bones, between them and the sella tursica, is seen an irregular opening for the passage of the carotid artery into the interior of the skull, called the *carotid canal;* which also allows the transmission of connecting branches between the sympathetic and the cerebral nerves. In the recent subject, a considerable quantity of cartilage separates this canal from a distinct fissure, which, in the skeleton, extends between the petrous portions of the temporal bones and the cuneiform process of the occipital: they are termed the *foramina lacera basis cranii anteriora.* They are more obvious on the external than on the internal surface of the skull, and have opening into them the terminations of the pterygoid canals. They transmit the pterygoid nerves, and also a branch of an artery to the dura mater. A groove, passing from this lacerated foramen, leads to the *foramen innominatum,* situated upon the anterior surface of the petrous portion of the temporal bone. This foramen leads to the canal of Fallopius, and gives passage to a branch of the peterygoid nerve. All the parts hitherto mentioned are anterior to the articulation of the head with the spine.

The *posterior division* comprehends all that portion of the base of the skull behind the posterior clinoid processes, and superior ridge of the petrous bones. The processes of this compartment have been sufficiently described, when speaking of the bones which enter into its composition. Contained in this division we have the track of the grooves for lodging the lateral sinuses: which, beginning at the internal tuberosity of the occipital bone, pass successively over the occipital, posterior angle of the parietal, mastoid portion of the temporal, and again on the occipital bone, to terminate in the foramina lacera basis cranii posteriora. The *foramen magnum,* which is situated in the median line, is proper to the occipital bone, and admits the spinal marrow, its membranes, and also the spinal arteries: it admits, likewise, the vertebral arteries, accessory nerves, and sinus venosus. On each side of this foramen are situated the *anterior condyloid foramina,* which open on the external base of the skull, between the condyloid processes and the foramina lacera. The *foramina lacera basis cranii posteriora* are produced by two sulci, formed into foramina by the junction of the temporal and occipital bones: they are situated on the outer and fore part of the foramen magnum, and appear externally between the anterior condyloid foramina, the fossæ jugulares and styloid processes of the temporal bones. The posterior condyloid may be seen opening into these lacerated foramina on the external base of the skull, for the purpose of admitting veins which pass through these openings, to terminate in the lateral sinuses. The foramina lacera bàsis cranii posteriora transmit the internal jugular veins, which are situated to the outer side of the accessory, glosso-pharyngeal and pneumogastric nerves, which also pass out of these openings: a small artery enters them, to supply the dura mater. On the posterior surface of the temporal bones, three foramina are to be observed: the principal of these are nearest to the median line, and are called the *foramina auditiva interna:* they take a direction outwards, and slightly backwards, into the substance of the temporal bones, but soon divide into two passages: one, the apparent continuation of the foramen, passes to the base of the modiolus, and allows of the passage of the auditory nerve, or portio mollis, into the labyrinth: while the other takes its course upwards, backwards, and lastly, downwards, to terminate at the stylo-mastoid foramen. In its course, being termed the canal of Fallopius, it transmits the portio dura, or facial nerve.

The two other foramina, which are very small, are for the purpose of allowing the evacuation of fluid from the cochlea and vestibule of the internal ear, and are named the *aquæductus cochleæ et vestibuli.*

It is usual to give a particular description of the external as well as of the internal base of the skull; but I consider that the manner in which I have traced the foramina from the interior to their external openings, will sufficiently combine the description of both surfaces.

Important Cavities produced by the Bones of the Face.

The Orbits

Are two large cavities, situated on either side of the nose, immediately below the superciliary ridges. They are of a conical form ; their base being in front, and the apex behind. Their direction is from behind to before, and somewhat from within to without; which circumstance tends much to enlarge the field of vision : but this advantage, perhaps, may be considered as secured by the cavity of the bony orbit being much larger than the ball of the eye itself.

Each orbit is composed of seven bones, although but eleven enter into the composition of the two; which apparent paradox is explained by three of the bones being *common* to the two orbits, viz. :—the frontal, the ethmoid, and the sphenoid.

The relative position of these bones, in the composition of each orbit, is as follows :—The os frontis is situated above, and forms the whole of the *roof* of the cavity: the *floor* is produced by the orbitar process of the superior maxillary bone. The malar and sphenoid bones constitute the outer wall: the inner wall receives the unguis and ethmoid bones: and lastly, the palate bone completes the small posterior part, or apex of the orbit. In each orbit are found several foramina, for allowing the passage of blood-vessels, nerves, and absorbents, to and from the eye and its appendages. At the posterior part two are placed — the *optic* and *lacerated foramina,* which have already been particularly described in speaking of the base of the skull. Above the orbit is situated the *supra-orbitar foramen:* allowing the passage of a branch of the first division of the fifth pair of nerves to supply the parts about the eye-brow, upper lid, and inner canthus of the eye. From the floor passes out the *infra-orbitar foramen;* which gives passage to a branch of the second division of the fifth pair, supplying sensation to the parts about the face. From the inner side, two small foramina lead into the interior of the skull: they are situated in that part of the transverse suture formed by the union of the ethmoid and frontal bones: the anterior one transmits a twig of the first division of the fifth pair of nerves, and a branch of the ophthalmic artery, which pass through some of the anterior foramina of the cribriform plate of the ethmoid bone into the nose. This distribution explains the watering of the eyes upon any pungent substance being applied to the nose. The posterior foramen admits only a branch of the artery which goes to supply the dura mater. These foramina are named the *foramina obitalia interna, anteriora* and *posteriora.* On the outer side of the orbit is placed the *foramen lacerum orbitale inferius,* or *spheno-maxillary fissure;* which is bounded above, by the sphenoid bone; below, by the superior maxillary; anteriorly, by the malar; and posteriorly, by the palate bone. It leads from the spheno-maxillary fossa, and admits the infra-orbitar nerve and artery, which pass through the floor of the orbit, and infra-orbitar foramen, to the face. The malar foramen also sometimes opens into the orbit.

Practical Remarks.

Exostoses sometimes grow from the orbitar processes of the bones forming the orbits, and destroy vision by pressure on the eye-ball. This disease may be mistaken for some malignant affection of the eye itself; but the diagnosis may be formed by close examination, before the naturally transparent parts of the eye have become opaque; upon which, if the disease be of the eye itself, it will be observable, shining like some metallic substance at the bottom of the organ: while, on the contrary, if it be exostosis, it is situated behind the sclerotic coat, and cannot therefore be discovered.

The Lacrymal Fossæ

Are placed on the inner side of the orbits, and lead into the lower chamber of the nose, as a long canal. They are formed by the ossa unguis, the nasal plates of the superior maxillary, and by processes of the inferior spongy bones. They contain the lacrymal sac and duct, which are continuous with the tunica conjunctiva above, and the pituitary membrane of the nose below.

Practical Remarks.

The duct is sometimes obliterated, and suppuration takes place in the sac, producing the disease termed fistula lachrymalis; the cure for which is to pass an instrument from the sac through the duct into the nose, and thus render the passage again pervious. This operation is performed by laying the sac open immediately below the attachment of the tarsi, to the nasal process of the superior maxillary bone: but, in doing this, care should be taken not to use so much force as to injure the delicate structure of the os unguis. A style is then passed down the duct, and allowed to remain there until the passage of the tears is perfectly re-established.

The Nostrils.

By this term is meant the bony part of the nose, forming the osseous cavity, for the protection of the more delicate structures which enter into the composition of the true organ of smell: for the cartilages, and softer anterior parts, are to be considered as subservient to the respiratory functions, which the nose assists in performing, rather than to the olfactory function.

There are fourteen bones which enter into the formation of the bony part of the nose, and which are placed in the following relative position :—The anterior convex part, which is termed the *bridge* of the nose, is formed by the ossa nasi, the nasal processes of the superior maxillary bones, and by the ossa unguis: the *roof* of the nose, by the under surface of the cribriform plate of the ethmoid bone: the *floor*, by the palatine processes of the superior maxillary and palate bones: while the *bony septum* is produced by the nasal lamella of the ethmoid bone, the vomer, the azygos process of the sphenoid bone, and by the nasal spine, assisted by the union of the palatine processes of the superior maxillary and palate bones. The cavity of the nose is rendered irregular by the inferior turbinated bones. This large cavity is divided into three chambers :—a *superior, middle,* and *inferior.*

The *superior chamber* is contained entirely in the ethmoid bone, being situated between its cribriform plate and turbinated portion. This chamber has opening into it the *posterior ethmoidal* and *sphenoidal sinuses.*

The *middle chamber* includes that portion bounded above by the superior turbinated bone, and below by the inferior, and into which open the *frontal* and *anterior ethmoidal sinuses,* by a common foramen: and also the *antrum highmorianum.*

The *inferior chamber* is placed below the inferior turbinated bone, between it and the palatine processes of the superior maxillary and palatine bones. The *ductus ad nasum* terminates in this cavity, immediately underneath the inferior turbinated bone.

An anterior opening, common to the three chambers, forms what is generally called the nostril; while it terminates behind, also, by a common opening into the upper part of the pharynx. The whole of the interior of the nose, as well as the sinuses communicating with it, are lined by the pituitary membrane. It is to be remembered that the nose is a double organ, and that therefore the parts described are found on each side of the septum.

The practical remarks connected with this organ will be better understood, when its relative position with the pharynx and the soft parts entering into its composition has been described.

The Mouth.

The osseous parts of this cavity are formed above, by the superior maxillary and palate bones, constituting the hard palate or roof of the mouth: laterally and below, by the inferior jaw. The thirty-two teeth also form a considerable portion of these boundaries.

Practical Remarks.

The numerous diseases to which the mouth is liable, arising from the various structures which enter into its composition, render it more desirable to defer their consideration until each structure is separately described.

LECTURE III.

THE BONES OF THE TRUNK.

THIS forms the second division of the skeleton, and is subdivided into the bones of the *spine*, the *thorax*, and the *pelvis*.

First Division of the Trunk.

The Spine.

The *spine* is composed of twenty-four separate bones termed the vertebræ, which are comprised under that class named the irregular bones. In conjunction they form a pyramidal pillar, its base resting on the pelvis, and supporting the head by its apex. It forms a canal along its whole length, to contain the spinal chord.

Each vertebra is characterized by its *body, bony arch, seven processes, two pair of notches,* and a *hole* for the spinal marrow. The *body* constitutes the principal part of the bone, and is situated anteriorly: its circumference is more or less rounded, having a slight concavity behind, to assist in forming the spinal canal: it is flattened above and below, for its connexion with the intervertebral substance. The texture of this portion of the bone is spongy. The *arch* is formed by two small processes of bone, passing backwards and inwards, and meeting in the median line; thus completing the *hole* for the spinal marrow. Of the seven processes, the first to be observed are the two *transverse,* which proceed from the arch, close to its junction with the body of the bone: they extend backwards and outwards with more or less obliquity, are of a compact structure, and are marked by the attachments of numerous muscles. The *articulatory processes* are four in number; two being situated above, and two below the transverse processes: the upper have a direction more or less backwards, and the lower ones forwards; thus forming a junction with the corresponding processes of the vertebræ above and below. The surfaces which come in contact with each other are covered with cartilage. From the centre of the arch, posteriorly, projects the *spinous process*, passing backwards and downwards with various degrees of obliquity. This process is of the same compact texture as the whole of the arch, and gives attachment to muscles. The *two pairs of notches* are situated above and below, between the body and articulatory processes. The inferior are the deeper of the two; and, by the junction of the vertebræ, they are formed into foramina, for the transmission of nerves from the spinal marrow. These are characteristics common to all the vertebræ: but, as they vary according to their situation and mobility, the column is divided into three distinct regions, viz.:—the *cervical*, *dorsal*, and *lumbar*.

The Cervical Region,

Which is composed of seven vertebræ, is placed between the chest and the head. The vertebræ of this region may be known by the following distinguishing marks:—The *body* bears a comparatively smaller proportion to the whole bone than in the other regions; it has its long axis extending laterally, it is hollowed above, from side to side, whilst below, it is hollowed from before to behind: the fore part of the body is flattened, to enlarge the surface of contact with the pharynx and œsophagus. The processes which form the arch are broad and large, extending so far backwards from the body as to render the spinal *hole* large and triangular. The *transverse processes* are short, and extend directly outwards: their extremities are bifid, and they are pierced at their roots by the *vertebral foramina*, which give transmission to the vertebral arteries and veins. The *articulatory processes* are placed rather behind the transverse; the *superior* are directed backwards, upwards, and rather inwards; the *inferior* forwards, downwards, and outwards. The *spinous process* is short, projects backwards, with a slight obliquity downwards, and, like the transverse processes, terminates in a bifid extremity—thus affording an increased surface for the attachment of muscles. A cervical vertebra may be easily known, by any one of these peculiarities: but the grand distinction, by which it may immediately be recognized, is the *vertebral foramen* in its transverse process.

Amongst the seven cervical vertebræ, we find three differing from the rest so as to require a particular description. These are the first, the second, and the seventh. The two former should be minutely examined, since, by their connexion with the occipital bone and with each other, they allow of the motion which takes place between the head and the spine, and regulate its extent. The *first cervical vertebra*, usually called the *atlas*, forms an exception to the general description of these bones, as we can neither recognize body nor spinous process. It consists merely of a bony ring, forming the vertebral hole. The internal circumference of this ring is rendered still more concave anteriorly, by being furnished with an articulatory surface to receive the dentiform process of the vertebra below. Behind this hollow the bone is marked on each side by the attachment of the transverse ligament, which passing behind the dentiform process confines it to its situation. This ligament may thus be said to divide the ring into two compartments, the anterior of which is the smaller, and lodges the dentiform process: the posterior is continuous with the circumference of the foramen magnum, and transmits the spinal marrow. The upper surface of the ring presents two *articulatory concavities*, converging anteriorly, and corresponding with the condyles of the os occipitis, which they receive. The bone is *rough* both before and behind these cavities, to give attachment to ligaments which connect it with the occipital. Only a slight motion, backwards and wards, is allowed between these two bones. The *inferior articulatory processes* are flat, placed horizontally, and face downwards and slightly inwards. The *transverse processes* are very large, but do not bifurcate at their extremities: a very *slight projection* occupies the place of the spinous process.

The *second cervical vertebra,* or *dentata,* is immediately distinguished by its strong and compact tooth-like projection, called the *dentiform,* or *odontoid process,* which, rising upwards from the body of the bone, is received into the hollow of the atlas anteriorly to the transverse ligament, where it is allowed to rotate. Its surface is *smooth* before to articulate with the vertebra; *smooth* also behind to articulate with the ligament. Its extremity is *rough,* for the attachment of ligaments connecting it with the edges of the foramen magnum. The *superior articulatory processes* are flat, and face upwards and outwards, corresponding with the inferior of the atlas, and allowing an extensive rotatory sliding motion between these bones. The *transverse processes* are small, and point downwards. The *spinous process* is large and strong. The *spinal hole* is triangular. The *superior notches* are placed behind the articulatory processes, and are very slightly marked. The *inferior* are situated, as in the other vertebræ, between the articulatory processes and body of the bone. All the lateral horizontal motions of the head are effected between these two vertebræ, during which the dentiform process rotates in the cavity of the atlas, and the articulatory processes of the two bones slide the one upon the other. To allow of this motion, the atlas and vertebra dentata are not connected with each other by intervertebral substance.

The *seventh cervical vertebra* differs from the rest, by approaching somewhat in its form to those of the dorsal region, and may be considered as a sort of link between the two divisions, which it unites. Thus we find its *body* larger and more rounded. Neither the *transverse* nor *spinous process* are *bifid,* whilst the latter is lengthened and inclined somewhat downwards. The grand characteristic, however, still remains, viz., the *vertebral foramen,* which here transmits, not the vertebral artery, but its corresponding vein. The artery passes before the transverse process of this vertebra, which it sometimes slightly grooves.

The Dorsal, or Thoracic Veretebræ,

Are *twelve* in number. They form the posterior boundary of the cavity of the thorax, and support the ribs. A general description of them offers the following distinguishing marks:—They are much *larger* in every direction than the cervical. The *body* has its long diameter from before to behind; is *prominent* anteriorly; and somewhat *concave* from above to below: its superior and inferior surfaces are flattened. On each side of the body, just anterior to its junction with the arch, we observe two half *articulatory surfaces:* one at the upper edge and one at the lower. These, by joining with corresponding surfaces on the vertebræ above and below, form the *articulatory cavities* for receiving the heads of the ribs: so that the head of each rib is received between two vertebræ, to both of which it is articulated. The *arch* is strong, and almost entirely occupied by the processes which arise from it: it is smaller than in the cervical vertebræ, and the *spinal foramen* is consequently reduced in size, and *rounded.* The *transverse processes* are strong, projecting horizontally outwards and backwards: they are deeply marked by the attachment of muscle and ligament, and on the anterior surface of their extremities is an *articulatory depression* for receiving the tubercle of that rib, the head of which is connected with the superior cavity on the side of the body. The transverse processes increase in length, and have a tendency to incline downwards from the first to the seventh, below which they again become shorter and more horizontal. The processes of the eleventh and twelfth are particularly small, and do not articulate with the ribs. The *articulatory processes* of the dorsal vertebræ are placed vertically; the superior directed *backwards* and *outwards;* the *inferior, forwards* and *inwards:* their surfaces are flat.

The *spinous processes* are long, and pass with great obliquity downwards. Their posterior surface presents a sharp ridge, to receive which there is generally a groove on the under surface of the process above. The spinous processes of the dorsal vertebræ increase in length, and incline more downwards from the first till about the eighth, below which they become shorter and more horizontal, resembling those of the lumbar region.

The *notches* are large, and strongly marked at the lower edge: more slightly, above. There are in this region, as in the cervical, some distinguishing marks, by which certain vertebræ of this class may be recognised: the *first, tenth, eleventh* and *twelfth,* are of this description. The *first* presents, on each side of its body, two articulating surfaces,—a whole one above for the first rib, and a half one below for the second. The *tenth* has a single half-articulatory surface only, on the upper edge of each side of its body, for the junction of the tenth rib.

The *eleventh* and *twelfth* dorsal vertebræ are alike; both having an entire articulatory surface on each side of their bodies for their respective ribs, and having none on their transverse processes: but they may be known from each other by the *twelfth* having its inferior articulatory surfaces directed outwards, and somewhat convex; resembling, therefore, in that respect, the lumbar vertebræ.

The grand distinguishing mark of the dorsal vertebræ is the articulating surfaces, for the attachment of the ribs.

The Lumbar Vertebræ

May be at once known from the rest by their greater size, and also, negatively, by not being furnished either with a foramen through their transverse processes, or with articulating surfaces for the ribs. Their *body* bears a great proportionate size to the whole of the bone, has its long axis from side to side, and is slightly concave from behind to before, both upon its superior and inferior surfaces. Their *articulatory processes* are large and elongated: the *superior* are concave, oval in form, and are directed backwards and inwards, having rather a tendency to diverge: the *inferior*, on the contrary, rather converge, are convex, oval, and face forwards and outwards, admitting a considerable degree of lateral motion. Their *spinous process* is large, long, takes a horizontal direction backwards, and is flattened laterally. The *transverse processes* are thin, long, and pass horizontally outwards, having a slight inclination upwards: they are placed on a plane anterior to the transverse processes of the dorsal region. Their *spinal hole* is large and triangular; and their *notches* form very deep sulci. The *fifth* lumbar vertebra may be known from the rest of this region by having the lower surface of its *body* oblique, so that the anterior part of its body is much deeper than the posterior: and also, from having the extremity of its *spinous process* hooked downwards towards the sacrum.

The Spinal Column.

The union of these twenty-four bones constitutes the *vertebral column:* the *use* of which is, to support the head, to form a part of the chest, to protect the spinal marrow, and to offer an extended surface for the attachment of muscles. Of the mechanism by which it is so perfectly adapted to its numerous offices, I shall defer to treat, until I come to speak of the skeleton in general: for the functions of the spinal column can be neither appreciated nor understood, by abstract and insulated considerations. It ought, however, to be borne in mind, that the spine forms the great medium of connexion between all the parts of the body; and that, necessarily, numerous muscles are attached to its whole length.

Attachment of Muscles.—Those muscles attached to the spine are principally for the purpose of keeping the trunk and head erect, and many of them moreover are muscles of respiration. They are placed in the following order:—*Posteriorly* are found the m. trapezii, latissimi dorsi, rhomboidei majores et minores, levatores scapulæ, serrati postici superiores et inferiores, splenii, sacro-lumbales, longissimi dorsi, spinales dorsi, cervicales descendentes, transversales colli, trachelo-mastoidei, complexi, recti capitis postici majores et minores, obliqui capitis superiores et inferiores, semispinales dorsi, semispinales colli, multifidi spinæ, intertransversales et interspinales colli, dorsi et lumborum, obliqui abdominis interni. In the *anterior region*, m. longi colli, recti capitis interni majores et minores, recti capitis laterales, diaphragma, quadrati lumborum, psoæ magni et parvi. *Laterally*, m. scaleni antici, medii et postici, and the transversales abdominis.

Practical Remarks.

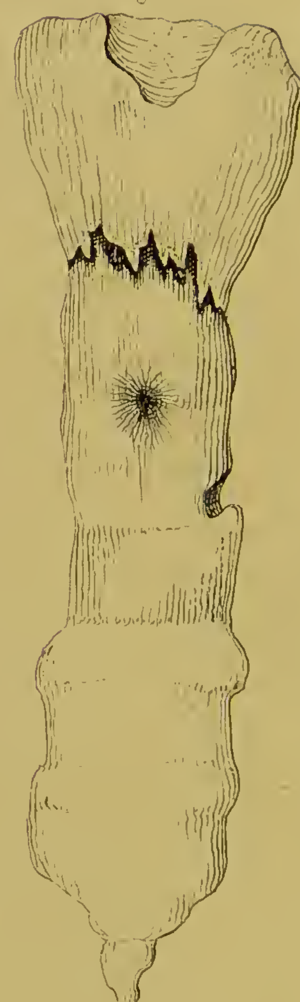
Fractures of the spine are difficult to detect, from the little displacement which occurs: but the best mode of examining a patient who has suffered from this accident, is to place him with his face downwards; and by pressing the palm of one hand firmly on one side of the spine, trace the spinous processes with the other from the neck to the sacrum. When you arrive at the displaced vertebra, you will find it thrown a little out of its line, where a hollow in the part is perceptible.

Symptoms.—Paralysis immediately ensues of all the parts beneath the injury: and it is remarkable, that when this accident occurs in the male, that the penis is found in a half erected state. The abdomen is tympanitic, the fæces are passed involuntarily, and the urine is retained: the latter symptom, however, in cases where the sufferer lives for a considerable length of time, becomes changed to an involuntary discharge. The passing away of the fæces is to be explained by the paralysis of the sphincter ani, and the continued peristaltic action of the intestines: while the muscular coat of the bladder, being no longer stimulated by the accumulation of urine, is rendered incapable of contraction, and the water is consequently retained. There is no instance recorded of a permanent recovery from this accident; as it seems impossible that the vertebræ should be fractured, without mischief to the spinal marrow. When the lower part of the spine is the seat of injury, the patient will, in some cases, live for six weeks, or even longer: but when the fracture happens above the fourth cervical vertebra, death immediately ensues. If the fracture take place at the bottom of the neck, the patient may survive nine or ten days. These results depend upon the degree of interrupted function, which the nerves distributed to the muscles of

Plate 2.

Fig: 1.

Fig: 2



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respiration experience. The late Mr. Henry Cline recommended the removal of the depressed portion of the vertebra, upon the same principle that trephining is employed in fractures of the skull; and he performed the operation in one case, but unsuccessfully. Mr. Frederic Tyrrell has since performed it in two instances, with a like want of success. *Vide Plate* 2, *Fig.* 1., in which the position of the spinous process of the fractured vertebra is delineated.

Second Division of the Trunk.

The Thorax.

The *chest* is a large conoidal cavity, placed anterior to the twelve dorsal vertebræ: it is composed of bones, to give it firmness; of cartilage, to render it flexible; and of ligaments, to tie those parts together. The bones which enter into its composition may be thus enumerated:—The *sternum*, forming the anterior boundary, and placed in the median line of the body: and twelve *ribs*, situated on each side of it, which are more or less connected with the sternum in front, and with the twelve *dorsal vertebræ* behind. The dorsal vertebræ form the posterior boundary to the chest.

The Sternum.

This bone is situated in the middle line of the body, and is divided in early life into three portions, which are not connected with each other by bone until the adult period. They are, however, so firmly united by cartilage as to move, during respiration, as a single bone.

The *upper* piece of the sternum is somewhat of a triangular form, the base being placed above, and the apex below. It is, superiorly, *notched*, so as to give it somewhat the appearance of a heart: on each side of which notch is situated an *articulatory surface*, for the junction of the clavicles. On each of its lateral edges are placed *one whole* and *one half* articulating surface, for the perfect attachment of the cartilages of the first rib, and for half of the second. The *inferior edge* is rough, for its connexion with the second piece. *Anteriorly* this portion of the sternum is *flattened: posteriorly* it is *concave*, to enlarge the upper part of the chest, for the passage of the œsophagus and trachea.

The *middle piece* is nearly of the same thickness and breadth throughout its whole length: it forms by far the most considerable portion of the sternum. Its *superior edge* is attached to the upper piece. *Inferiorly* it is connected with the lower portion; and laterally it offers, on each side, a *half articulatory surface* for the second rib; a *whole* one for the third, fourth, fifth, and sixth; and *half* a one for the seventh.

The *inferior piece* is usually found cartilaginous at its extremity, which is termed the *ensiform cartilage.* It is smaller than either of the others, and presents but *half* an articulating surface on each side, for the attachment of part of the cartilage of the seventh rib.

The *use* of the sternum is to assist in forming the thorax, and to defend the heart and lungs. It forms a medium of attachment for the ribs, acts as a fulcrum for the clavicles to roll on, and gives attachment to several muscles.

Attachment of Muscles to the sternum are the m. pectorales majores, sterno-mastoidei, sterno-hyoidei, sterno-thyroidei, subclavius sterno-costalis, diaphragma, the recti abdominis, and intercostales interni.

Practical Remarks.

The degree of motion which the sternum enjoys, from the elasticity of the cartilages of the ribs to which it is connected, secures it from the frequent occurrence of fracture. Nevertheless, this accident does sometimes occur, from the application of a concentrated force; and an effusion of blood into the surrounding parts is the consequence. But little displacement of the fractured portions of the bone occurs, in consequence of the elasticity of the cartilages of the ribs. If the bone be comminuted, and driven inwards, it may interfere with respiration, and render it necessary to remove the fractured portion with a trephine. *(Vide Plate II., Fig. 2.)* Suppuration subsequent to this accident might also produce symptoms warranting such an operation. In a case of simple fracture of the sternum, a bandage should be applied round the chest, with a degree of pressure sufficient to prevent the action of the intercostal muscles; and the patient should be placed in a position, with the head and pelvis raised: in this manner the sternum is removed, as it were, from the influence of muscles. It is almost invariably right to abstract blood from the arm: at any rate, the antiphlogistic regimen is essential.

The Ribs.

The *ribs* consist of a succession of long slender bones, which form the sides and great part of the posterior boundaries of the thorax. They are twenty-four in number; twelve of which are placed on each side. They are attached, by their posterior extremities, to the twelve dorsal vertebræ. Anteriorly, they form a junction with the sternum, by means of an intervening cartilage: whilst below, they are attached to each other by a similar structure. The difference observable in their anterior articulation, distinguishes the ribs into two classes, the *true* and the *false ribs.* The true ribs, comprising the seven superior, are connected successively with the three portions of the sternum; into the articulatory cavities of which bone their cartilages are received, and thus form more particularly the walls of the thorax. The five inferior, or false ribs, may be considered as forming a part of the abdominal parietes, as they defend the viscera in the upper part of that cavity. They are not continued forwards, as far as the sternum, but terminate by each joining its cartilage to that of the rib immediately above: the two last are to be excepted, which, from having their extremities unattached, and merely tipped with cartilage, have received the name of floating ribs. The length of the ribs increases successively from the first to the seventh, and then gradually diminishes to the twelfth: the first is placed horizontally, while the others are more or less inclined downwards from the vertebral column. They all diverge in passing from the spine, and converge in passing to the sternum. No two ribs on the same side are alike; but, as a general description, we distinguish on each the following parts:—A *head*, a *neck*, a *tubercle*, an *angle*, a *body*, and an *extremity*. The *head* forms the posterior or vertebral extremity of the bone; is somewhat spread out; and on it we observe two *articulatory surfaces*, divided by a ridge. These surfaces are received into the articulatory cavities on the bodies of the two dorsal vertebræ, between which each rib is placed; while the *interarticular ridge* corresponds to the intervertebral substance, with which it is connected by ligament. Anteriorly to the head, the rib becomes contracted and somewhat rounded, forming what is called the *neck*. This part is about an inch in length, roughened for the attachment of ligaments, and extending downwards and outwards, terminates in a little rounded eminence, situated at the back part of the bone, called the *tubercle:* this tubercle has a convex *articulatory surface*, to be received into a corresponding cavity, situated on the transverse process of the lower of the two vertebræ with which the head is connected. Both the neck and the circumference of the tubercle are rough, for the attachment of ligament and tendon. The remaining portion of the rib is called the *body*, which, after passing for a short distance in the same direction as the neck, turns suddenly forwards, and thus produces a very considerable curve, which is called the *angle;* the position and shape of which are different in each rib. Beyond the angle, the body is found to pass forwards, with a gentle curve, towards the sternum, at a short distance from which it terminates in what is called the *extremity*. The body becomes flattened immediately after leaving the tubercle, and presents two smooth surfaces: the external, convex; and the internal, concave, for the purpose of enlarging the thoracic cavity. Its superior edge is rounded, and smooth; its inferior, sharp, and grooved internally, to receive the intercostal artery, veins, and nerve. This groove commences at the tubercle; and, becoming gradually less distinct, is lost about the middle of the bone. Both the edges give attachment to the intercostal muscles. The extremity of the rib is slightly expanded, of a spongy texture, and hollowed, to receive the cartilage, with which it is inseparably connected. These cartilages are not continued in the same direction as the ribs themselves, but pass very obliquely upwards, so as to form, by their junction with the sternum, an angle, obtuse above, and acute below. This inclination of the cartilages upwards, increases from the first rib downwards. Lastly:—In viewing a rib, we observe that it presents a *twisted* appearance, as if the two extremities had been turned round in a contrary direction. The degree of this twist varies in each rib in such a manner, that the rib shall always present its flat internal surface towards the lung, under the different motions which each exerts during respiration: and thus, although the size of the thoracic cavity is altered, its plane continuous surface is preserved.

Having described the general character of the ribs, it will be proper to mention some of the number which, from certain peculiarities, may be distinguished from the rest: for although every rib varies somewhat from its neighbour, either in form or position, yet the gradations of difference are so slight, as to render it difficult, or almost impossible, to name the precise condition of each. We may, however, recognize the *first*, the *seventh*, the *ninth*, the *eleventh*, and the *twelfth*. The *first* is known by its small size, and incurvated form, completing about half of a circle: it is very broad and flat, one of its two *surfaces* facing *upwards*, and the other *downwards*. On the superior surface there are two slight grooves, marking the course of the subclavian artery and vein; between which a small *tubercle* is situated, for the attachment of the scalenus anticus muscle. Its *angle* and *tubercle* are situated on the same spot. Its *head* has only one articulatory surface, corresponding with that on the first dorsal vertebra.

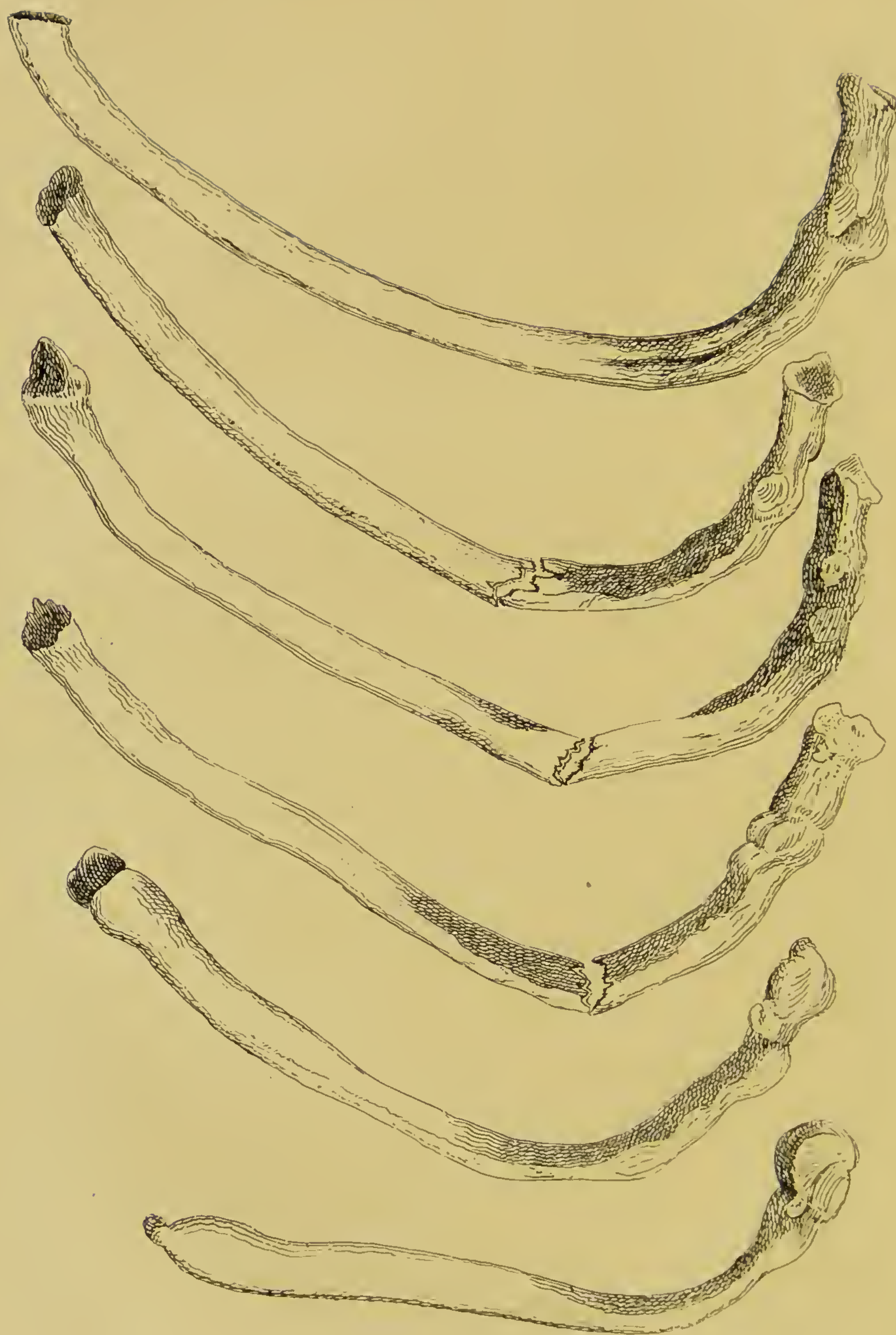
From the first, the ribs increase in length to the *seventh*, which is the longest of all, and may be known by that circumstance. After this, they again decrease to the last. The distance between the *tubercle* and the *angle*, and indeed the curve of the angle itself, will be found to *increase* regularly from above to below, as far as the *ninth*, where they both attain their maximum: which enables us to distinguish that particular bone. In the two or three superior ribs the angle is hardly to be recognized at all, it is so involved in the general curve of the rib: the same remark also applies to those below the ninth. The *eleventh* and *twelfth* ribs, are distinguished by having *whole* articulatory surfaces on their heads, to correspond with the two lower dorsal vertebræ; but as they do not articulate with the transverse processes of the corresponding vertebræ, they are *destitute* of tubercles: their extremities are likewise unconnected. The curve formed by the bodies of the ribs will be found gradually to diminish, from the first to the last; and the tubercles will be seen to face in a more downward direction in the same ratio.

Having thus given a description of the several ribs, and mentioned the peculiarities of each, we may next take a view of the cavity formed by them: by the sternum, before, and by the dorsal vertebræ, behind. This cavity is of a conical shape; having its apex above, and its base below: a form which will at once indicate the differences which must exist in each bone, in order, by their combination, to produce it. Thus we find the curve of the ribs diminishes, while their length increases, from above to below. It is true, that, after the seventh, they again become shorter; but this does not interfere with the general contour of the cone: for, as their curve still continues to decrease, the only effect produced by their diminution in length is, that they terminate sooner, and thus leave the fore part of the cavity defective below; just as if an oblique section had been made of the cone, from above to below, towards the spine. The direction, also, of the two surfaces in the different ribs, the situation of the angles, the obliquity of the cartilages, and all the other variations already described, will be found contributory to the production of a conical cavity, and to the adaptation of that cavity to the different degrees of motion, and alterations in size and shape, which it is destined to undergo during respiration.

It is worthy of remark that the ribs do not run in lines parallel with each other, but have a tendency to diverge as they

Plate 4.

p. 89.



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pass from their spinal articulations. Their cartilages, on the contrary, converge as they pass forwards and upwards, being brought almost in contact with each other, where they reach the sides of the sternum. Thus if we draw three lines from the top to the bottom of the thoracic cavity, one through the bony extremities of the ribs, another through their heads, and a third through the sternal extremities of their cartilages: the first line will be found the longest, the second shorter than the first, and the last shortest of all. This circumstance refers more particularly to the seven true ribs. The peculiar motion of the ribs during respiration, and the manner in which this motion tends to increase and diminish alternately the capacity of the thorax, will be fully described in taking a review of the skeleton in general.

The *muscles* attached to the ribs are the m. levatores costarum, intercostales externi et interni, sterno-costalis, diaphragma, quadrati lumborum, scaleni antici, medii et postici, sterno-thyroidei, sterno-hyoidei, subclavii, pectorales majores et minores, latissimi dorsi, serrati majores antici, serrati postici, superiores et inferiores, sacro-lumbales, accessorii ad sacro-lumbales, longissimi dorsi, cervicales descendentes, obliqui externi, interni, transversales, and the recti abdominis.

Practical Remarks.

The oblique position of the ribs, and their cartilaginous attachment to the sternum, defend them a good deal from fracture: but some of them are more liable to such an accident than others, particularly the middle ribs, which are neither so much protected by the upper extremity as those situated above, nor so flexible as those below. The ribs are generally fractured near their centre; and the accident may occur either from a blow applied immediately upon the fractured spot, or from the body being forcibly pressed against some unyielding surface, as the ground or a wall. The position of the fractured portions will depend upon the mode in which the force may be applied: if produced by a concentrated force, as by a blow from a hammer, the rib has a tendency to become straightened; the fracture commences internally, and we have formed a salient angle inwards, or towards the lungs. *(Vide Plate III.)* If, on the contrary, the sternum is forcibly driven inwards, we have the curvature of the ribs increased to such an extent, that the exterior surface of one or more of them gives way, and the salient angle is produced outwards. *(Vide Plate IV.)* The nature of the accident may be ascertained by placing the finger on the suspected rib, near to the spine, and tracing it to the sternum. When you arrive at the fractured point, either the depression or prominence of the bone will be discernible; whilst, at the same time, a crepitus may be felt. Or you may place the whole palm of the hand over the suspected part, and desire the patient to attempt a full inspiration, when a crepitus will also be distinguished.

The treatment consists in passing a broad girth, with a buckle and straps, tightly round the chest, so as to keep the ribs stationary during respiration, which, until union be effected, must be carried on by the diaphragm.

If the salient angle produced have a direction outwards, a compress of wetted linen should be applied over the part fractured: but if, on the contrary, it be directed inwards, two compresses should be forcibly applied at each extremity of the fractured rib, so as to produce a tendency to press outwards the displaced portions at the seat of fracture.

When the ribs are fractured on both sides of the chest, and opposite to each other, the bandage ought never to be applied. In such a case we must trust to bleeding and the antiphlogistic regimen only.

If emphysema follow fracture of the ribs, pressure may first be tried to prevent the further accumulation of air in the cellular membrane: if this should not avail, small openings ought to be made in the tumour by means of a lancet.

Dislocation of the ribs seems scarcely possible, from the numerous and strong ligaments which connect them with the vertebræ,—unless indeed it be from disease. Mr. Webster, of St. Albans, however, in examining a patient who died of fever, found the seventh rib dislocated, and its head anchylosed on the fore part of the spinal column.

Third Division of the Trunk.

The Pelvis.

The pelvis is a cavity of an irregular figure, composed of four bones: the *sacrum* and *os coccygis*, which form its posterior, and the *ossa innominata*, which complete its lateral and anterior boundaries. With respect to its general conformation, it is somewhat in the form of a basin, which is broader from side to side than from before to behind; whilst its perpendicular dimensions preponderate laterally. The sacrum and os coccygis form so perfect a continuation of the spine, that they are nearly as essential to that division of the trunk as to the pelvis itself. I shall therefore first describe them.

The Sacrum

May be considered as the largest bone of the spine, the weight of which column it receives, and transmits to the ossa innominata, with which it is laterally connected.

The form of the bone is triangular, presenting a *base* above, an *apex* below, an *anterior* and *posterior* surface, two *lateral edges*, and a *canal* for the spinal marrow. The *base* of the bone resembles very much, in its appearance, a lumbar vertebra, being furnished with a *body* for its articulation with the last bone of the spine. It has also two projecting *lateral processes* similar to the transverse processes of the vertebræ, and which, like them, give attachment to muscles and ligaments. Its *articulatory processes* are directed backwards and inwards: they are concave, and are connected with the inferior articular processes of the last lumbar vertebra. The *apex* offers below a small *roughened surface*, by which it is joined to the coccyx; and on each side of this surface is seen a *notch*, which is completed into a foramen by the junction.

The *anterior surface* of the bone is concave, smooth, and traversed by *four lines*, which mark the different pieces of which it was originally composed, and impart to it somewhat the appearance of anchylosed vertebræ. It presents *four pairs of foramina*, which communicate with the interior of the bone, and allow of the transmission of the anterior sacral nerves. The fifth pair of foramina are common to this bone and to the os coccygis.

The *posterior surface* is convex and very unequal, presenting in the middle line four or five compressed projecting portions of bone, somewhat resembling diminutive *spinous processes*. These are united, and form one lengthened vertical spine. This spine, however, is not continued the whole length of the bone; but terminates at the upper part of the inferior third of the sacrum, exposing the *sacral canal,* which is of a triangular form, and in the recent subject is closed in by the posterior sacro-coccygeal ligament. This canal is for the purpose of lodging the spinal marrow, and is continuous with that of the lumbar vertebræ. There proceeds from this canal, posteriorly, *four pairs of foramina,* to transmit small nerves from the spinal chord. Upon the posterior surface the notches are seen, which form the fifth pair of foramina by the junction of the os coccygis. These notches are, in this aspect, marked by two projections of bone, which are sometimes called the *cornua* of the sacrum.

The *lateral* or *iliac edges* of this bone, present two large *unequal triangular surfaces,* which are connected with corresponding surfaces of the ossa ilia by an intervening cartilage. Below these articular portions the edges are irregular and rough, for the attachment of the sacro-sciatic ligaments, and terminate in the small notches which have been described as forming, by their connexion with the coccyx, the inferior sacral foramina.

Connexion.—The sacrum is connected *above,* with the last lumbar vertebra; *laterally,* with the ossa innominata; and below, with the os coccygis.

Use.—To form the posterior part of the pelvis, to support the spine, to lodge and protect the spinal marrow, and to give attachment to muscles.

Muscles attached to the sacrum are the m. multifidi spinæ, longissimi et latissimi dorsi, sacro-lumbales, glutei maximi, pyriformes, coccygei, and the obliqui interni abdominis.

Practical Remarks.

In consequence of the deep situation of this bone, and its spongy texture, it is but little liable to fracture: such an accident, however, does now and then occur from the application of some great force, as the passage of a carriage-wheel over the bone, or a fall from a considerable height: and it happens, from the degree of violence necessary to produce the fracture, that it is usually attended with comminution. There are no muscles attached to this bone, which tend to displace the broken portions; and the dangers and difficulties to contend with are, the injuries inflicted upon the parts within the pelvis, and the tendency there is to suppuration, in consequence of the quantity of loose cellular membrane situated in that cavity. There is generally a great difficulty in forming a correct diagnosis, from the quantity of soft parts which cover the bone: but the leading features pointing out the nature of the accident are paralysis of the lower extremities, the incapacity of the patient to move the pelvis without excessive pain, and a sensation of grating of one bone against another. The treatment consists, first, in passing a catheter into the bladder, lest the urethra or bladder should be injured; and in applying a broad strap around the pelvis, so as to orevent any motion of the bones. Bleeding, low diet, and a strict observance of the horizontal posture are to be strictly enjoined.

The Os Coccygis

Is situated immediately below the sacrum, but does not form a continuous surface, being directed more forwards than the axis of that bone. Like the sacrum, in early age it is divided into four or five small bones, the upper one of which is the largest, but they diminish in size to the fifth: they are all wider than they are long, offering small lateral protuberances, somewhat similar to the transverse processes of the sacrum. The upper portion, or base, presents a middle part, the *body*, which is articulated with the apex of the os sacrum; and two *cornua* laterally, which, passing upwards, convert the notches of the sacrum into the fifth pair of sacral foramina. The fifth bone, if there be one, is small and rounded, having a direction rather upwards as well as forwards. The os coccygis is concave anteriorly, and convex posteriorly: the convex surface being somewhat roughened, for the attachment of the coccygeal ligament; whilst its lateral edges give attachment to the sacro-sciatic ligaments, and to the coccygeal muscles. This bone forms no part of the canal for the spinal marrow.

Connexion.—Only with the sacrum.

Use.—To form the posterior and inferior part of the pelvis, and to support the rectum. The sacrum and os coccygis are sometimes termed the false vertebræ; and the great distinction between them and the true vertebræ is, that they do not assist in the motions of the spinal column.

The *muscles* connected with this bone are the m. glutei maximi, coccygei, levatores ani, and sphincter ani.

Practical Remarks.

This bone is less liable to fracture than even the sacrum, for it is equally if not more deeply seated: whilst, from the motion it enjoys, it rather yields to the application of force than breaks. Fracture, nevertheless, occasionally happens from a fall on the buttock: the nature of the accident is indicated by a severe pain in the coccygeal region, and may be ascertained by examination *per rectum*: the pain is much increased by any attempt to walk, in consequence of the fibres of the gluteus maximus displacing the fractured portions. No kind of apparatus can be applied to assist the reunion of this bone. Rest, poultices, and the antiphlogistic regimen are to be strictly employed, to prevent the occurrence of suppuration.

The Ossa Innominata

Are two large irregularly-formed bones, constituting the fore part and sides of the pelvis, and the lower part of the abdomen. In the adult, each of them presents an extended surface, inseparable but by violent and arbitrary division: while, on the contrary, during the fœtal period of life, they are each naturally divided into the *ilium, ischium,* and *pubes;* and are connected with each other through the medium of an intervening cartilage, which subsequently becomes permanently ossified. They are further united in the formation of the acetabulum.

The *os ilium,* or hip-bone, is the largest, and highest in situation of the three bones which form the os innominatum. It is divided into two distinct parts: its thick portion, or *body,* entering into the composition of the acetabulum: and its thin *expanded portion,* forming the lateral boundary of the pelvis. The body forms the anterior and lower portion of the ilium, and presents an *articulatory surface,* which produces rather less than two fifths of the acetabulum: from this portion of the bone there passes upwards its large expanded surface, which terminates above in a semilunar edge, termed the *crista*. It is roughened, and forms three distinct lines, which are named the *labia*—an *external labium*, giving partly attachment to the m. obliquus abdominis externus: a *middle one*, from which arises the m. obliquus abdominis internus: and an *internal one*, for the origin of the transversalis abdominis. This crista terminates anteriorly and above in the *anterior* and *superior spinous process*, which is the most projecting part of the bone: it gives origin to the m. sartorius, tensor vaginæ femoris, and attachment to Poupart's ligament. About an inch below this, is situated the *anterior* and *inferior spinous process:* it gives attachment to a part of the m. rectus femoris. The crista terminates posteriorly in like manner as it does anteriorly, in two processes, viz.:—The *posterior* and *superior*, and the *posterior* and *inferior spinous processes*. The sacro-iliac ligaments are here attached, uniting the ilium to the sacrum. The expanded portion of this bone presents an external irregularly convex surface, termed the *dorsum;* and an internal concave one, denominated the *venter*. Upon the dorsum, asperities are seen, which give attachment to the three glutei muscles. A semilunar line is produced by some of these asperities, extending from the anterior and superior spinous process backwards to the sciatic notch, for the origin of the gluteus minimus. The internal concave surface is divided into two unequal portions by a ridge; anterior to which the bone is regularly concave, for the attachment of the iliac muscle, and has already been denominated the venter: while, posterior to this ridge, is seen a large, irregular, and rough superficies, presenting, below, a *beak-like* articulatory surface, which, through the medium of an intervening cartilage, connects it with the sacrum: and, above, strong irregularities, for the attachment of those ligaments which strengthen this articulation. From the anterior part of the sacro-iliac symphysis, and passing forwards to where the ilium is connected with the pubes, is a distinct line, termed the *linea ilio-pectinea;*

which, when completed by the pubes, forms the line of demarcation between the cavities of the abdomen and pelvis.

The *notches* found upon this bone are two anteriorly, and one large one posteriorly. Those anteriorly, are one between the two anterior spinous processes, which is filled up by the iliac muscle, and is termed, therefore, the *iliac notch:* while the one below the anterior and inferior spinous process, between it and the body of the bone, allows of the passage of both the psoas and iliac muscles out of the pelvis, and may therefore be designated the *ilio-psoal notch.* The posterior notch, the longest of the three, is placed immediately beneath the posterior and inferior spinous process, forming the upper part of the great ischiatic notch. Several foramina may be seen on both surfaces of the bone, for the entrance of the nutritious vessels.

Connexion.—The ilium is connected with the ischium and pubes, in forming the acetabulum ; and also with the body of the pubes, by the linea ilio-pectinea ; with the sacrum, posteriorly, by the sacro-iliac symphysis ; and with the head of the thigh-bone, by enarthrosis.

The Os Ischii

Is situated at the lower and lateral part of the pelvis, and is of a very irregular form ; but we may distinguish upon it the following parts :—A *body, spinous process, neck, tuberosity,* and *ascending ramus.* The *body* of this bone forms its thickest portion, and is furnished anteriorly with an *articulatory surface,* constituting the lower and back part of the acetabulum, of which cavity it forms rather more than two fifths. From the posterior part of the body projects inwards the *spinous process,* forming the lower anterior boundary of the upper division of the ischiatic notch, and giving attachment to the anterior sacro-sciatic ligament, the m. geminus superior, levator ani, and coccygeus. Below the body of the bone it is slightly contracted, to form the *neck,* which is rendered more or less smooth, immediately beneath the inferior edge of the acetabulum, by the action of the obturator externus muscle. The anterior edge of the neck and body form a *semilunar sharp ridge,* constituting the posterior boundary of the obturator foramen. Below the neck is situated the *tuberosity,* which is the portion of the pelvis upon which we rest in the sitting posture. This process is rough behind, for the attachment of muscles of the lower extremity. Anteriorly it is hollowed out, to assist the neck in forming the obturator foramen: and internally, immediately beneath the spinous process, is situated a *sulcus,* which allows of the passage of the obturator internus muscle out of the pelvis: and on this region a second *furrow* may be seen extending along the lower margin of the tuberosity towards the ascending ramus, which lodges the internal pudic artery. Extending obliquely upwards and forwards from the tuberosity, is the *ascending ramus* of the *ischium,* which presents two flattened *surfaces,* and two *edges.* The anterior edge assists in forming one side of the pubic arch, and the posterior bounds the inferior and anterior portion of the obturator foramen. The internal surface is directed inwards and backwards, to produce a part of the lower circumference of the pelvis; and the external is rough, for the attachment of some of the muscles of the hip-joint.

Connexion.—The ischium is joined anteriorly and inferiorly to the pubes, by its ascending ramus: to the ilium and pubes, within the acetabulum, of which it forms the under and largest part. In conjunction with the pubes, it also forms the obturator foramen.

The Os Pubis

Is the smallest of the three bones which form the os innominatum: it is divided into its *body, horizontal plate, spinous process, symphysis,* and *descending ramus.* The *body* is the thickest part of the bone; and is furnished, at its femoral extremity, with an *articulatory surface,* which forms the anterior and inner one fifth of the acetabulum: in the formation of which, it is connected above with the ilium, and below with the ischium. At the point of junction with the latter, there is produced a deep sulcus between the two, so as to render the acetabulum much shallower at this point. This notch is situated at the under and fore part of the acetabulum, close to the obturator foramen, and is itself completed into a foramen by the cotyloid ligament. Proceeding inwards from the body, towards the opposite pubes, is situated the *horizontal plate* of the bone, forming a considerable portion of the brim of the pelvis. This plate presents a *posterior* and an *anterior ridge,* with an intervening *flattened surface:* the posterior ridge constitutes that portion of the linea ilio-pectinea which stretches from the junction of this bone with the ilium to the *spinous process,* to assist in the formation of which it terminates. The pubic fifth of this ridge has Gimbernat's ligament attached to it. The *anterior ridge,* extending from the body to the under part of the spinous process, forms the upper boundary of the obturator foramen, and gives attachment to the m. obturator externus. The *flattened surface* between the two ridges forms a posterior boundary, to what is called the crural arch; through which arch, muscles, vessels, and nerves, pass from the pelvis to the thigh. Midway between the anterior and superior spinous process of the ilium and the symphysis of the pubes, and behind Poupart's ligament, we find, upon the flattened surface just described, a groove or hollow, along which passes the femoral artery: it is at this point that pressure may be effectually made to arrest the flow of blood through that vessel. The *spinous process* already alluded to, is that small projection of bone, produced by the termination of the two ridges of the horizontal plate: it projects rather anteriorly, so as to be readily felt in the living subject. It is of importance to be well acquainted with the situation of this process, as it affords us considerable assistance in discriminating certain varieties of hernia. That rough portion of the bone, extending downwards from the spinous process to the descending ramus, is termed the *symphysis,* or point of junction between this bone and its fellow on the opposite side. The anterior and posterior surfaces of the bone at this part, give attachment to the ligaments which strengthen this articulation. The *descending ramus* is that portion of the bone which extends from the symphysis downwards, to meet the ascending ramus of the ischium; thus completing the periphery of the obturator foramen: whilst the junction of the ossa pubis and their descending rami, form what is called the arch of the pubes.

Connexion.—The pubes is attached by its body within the acetabulum to the ilium above, and to the ischium below: it is also connected by its descending ramus again with the ischium; and by this junction the foramen obturatorium is formed. The proportions in which the ossa innominata form the acetabula are as follow:—The ilium rather less than the superior two fifths; the ischium rather more than the inferior and posterior two fifths, which is not only the largest but the deepest part of the acetabulum; and the remaining anterior one fifth is completed by the pubes. It is within this cavity that the three bones composing it are connected with the femur by enarthrosis.

Attachment of Muscles.—To the ossa innominata are attached the m. obliqui externi et interni, transversales, recti et pyramidales abdominis, psoæ parvi, iliaci, levatores ani, obturatores externi et interni, coccygei, quadrati lumborum, longissimi dorsi, sacro-lumbales, latissimi dorsi, tensores vaginæ femoris, sartorii, glutei maximi, medii et minimi, recti femoris, gemini, quadrati femoris, bicipites flexores cruris, semitendinosi, semimembranosi, transversi perinæi, transversi perinæi alteri, erectores penis vel clitoridis, tricipites, adductores, femoris, graciles et pectinei.

General description of the Pelvis.

I shall now describe the principal anatomical points to be considered with respect to the pelvis, taken as a whole. When articulated it forms a basin, well calculated to sustain and defend the organs situated within its interior, and at the same time offers extended surfaces for the attachment of numerous muscles and ligaments, which assist in closing in its openings, and preventing thereby the displacement of its viscera. To understand the relative position of the separate bones entering into the composition of the pelvis, and their processes, which have been mentioned in the description of each bone, this part should be studied most carefully as a whole. It may be divided, for the purpose of facilitating the description, into four regions: an *anterior*, two *lateral*, and a *posterior region.* In the *anterior region* may be observed externally the rami of the ischia and pubes; diverging, as they descend, towards the tuberosities of the ischium, and leaving a large opening from the pelvis, but which, in the recent subject, is filled up by the deep fascia of the perineum, and the organs of generation. The upper part of this opening is called the arch of the pubes. It is formed by the symphysis pubis, which is visible in the central line. Immediately under the symphysis, and through this arch, the urethra passes. On each side of the symphysis, and extending downwards in the course of the rami of the pubes, is situated the foramen obturatorium, occupied, in the recent subject, by ligamentous tissue: and a little further outwards, on each side, may be observed the cotyloid cavity which receives the round head of the femur.

In each of the *lateral regions* are seen, externally, the dorsum ilii above, and sacro-sciatic notch below: the latter of which is filled up by ligaments, muscles, nerves, and vessels, in the living subject, so as to prevent the protrusion of the pelvic viscera.

In the *posterior region,* outwardly, may be observed the sacrum; its ridge in the centre of its four pairs of foramina; and at the lower part the spinal canal: but the spinal marrow is here protected during life by a firm ligamentous matter which closes the canal, and is termed the sacro coccygeal ligament. The os coccygis is also seen in this region, taking a direction rather forwards.

On viewing the pelvis internally, it will be seen to form two cavities, being bisected by the linea ilio-pectinea. The upper cavity is formed by the base of the sacrum and the expanded surfaces of the ilia; and the lower is bounded, anteriorly, by the ossa pubis; laterally, by the ischia; and posteriorly, by the united sacrum and os coccyx, and by the ischiatic notches.

The pelvis also presents two circumferences; an upper and a lower one. The *upper one* may be traced from where the lumbar vertebra unites with the sacrum, to the anterior and superior spinous processes of the ilia, the circle being completed in the recent subject by the abdominal muscles, thus forming the upper or abdominal cavity of the pelvis. The *inferior circumference,* or outlet, is marked by three *eminences,* viz., the tuberosities of the ischia and the os coccygis; and by three *depressions,* the arch of pubes in front, and the two ischiatic notches laterally. It is the comparative difference in the distance of these parts from each other, which constitutes the grand distinguishing mark between the male and the female pelvis,—the outlet being much more capacious in the female than in the male. But besides this characteristic of the female pelvis, all its lateral dimensions greatly preponderate: while, in the male, the perpendicular dimensions are most considerable.

The great size of the outlet from the female pelvis is to facilitate parturition; and in a well-formed skeleton the following measurements are given:—From the upper part of the arch of the pubes, to the articulation of the os coccygis with the sacrum,—from one ischium to the other,—and also from the pubes to the sacro-iliac symphysis, the distance, in each direction, being four inches, comprising therefore a circle, the diameter of which is four inches,—consequently, its circumference is about twelve.

Parts formed by the Union of the Bones of the Pelvis.

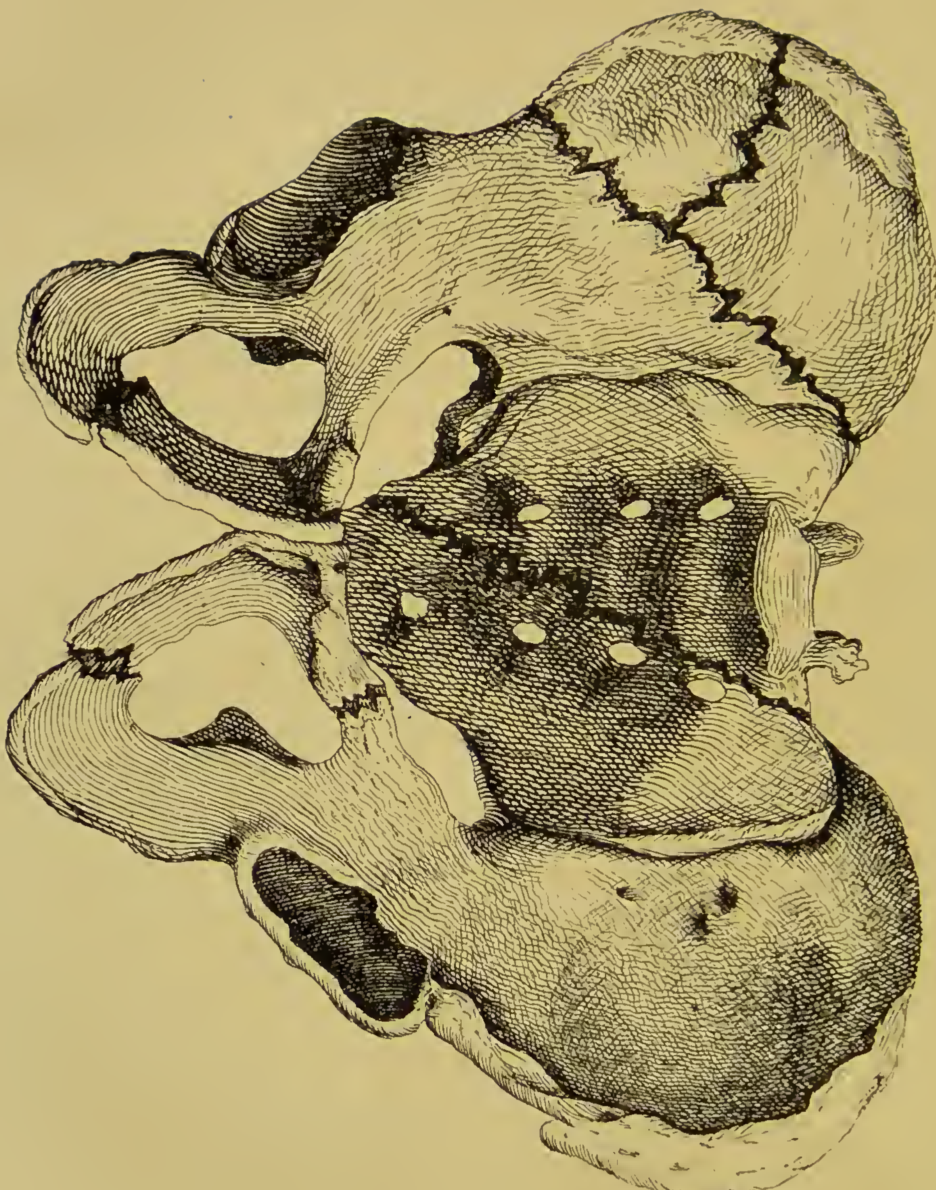
First:—The *acetabula*, or *cotyloid fossæ*. The proportions in which the bones forming the ossa innominata constitute these cavities, as well as their relative position, have already been detailed; but it still remains for me to give some account of their general conformation. Each acetabulum is of considerable depth, to receive the head of the femur: its interior is covered with cartilage, excepting at its inner and lower part, where the ligamentum teres is implanted into the bone itself. The acetabulum has a direction forwards, downwards, and outwards, and its circumference is roughened for the attachment of the capsular ligament: its lip in the recent subject is rendered more prominent, and consequently the cavity itself deeper, by a fibro-cartilaginous tissue, termed the cotyloid ligament, which passes round the cup, and at the interior and under part, where it stretches from the body of the ischium to the pubes, converts the notch formed by these two bones into a foramen. This foramen allows of the transmission of blood-vessels into the interior of the joint, whilst a slight groove leads from this notch to the obturator foramen, shewing the direction of the vessel.

The *foramina obturatoria* are produced by the junction of two of the bones of the pelvis—the ischium and pubes. They are large oval foramina, bounded above, by the horizontal plate of the pubes; below, by the ischium; before, by the rami of the pubes and ischium; and, posteriorly, by the acetabulum. They are filled up by ligament and muscles, leaving only a small opening for the passage of the obturator vessels and nerves.

The *Ischiatic notches* are two large irregular apertures, leading from the interior of the pelvis, and are directed backwards and outwards. They are bounded by the ilium above and before; by the ischium in front and below; and posteriorly above, by the lower portion of the sacrum; and beneath, by the os coccygis. In the skeleton, the inferior boundary is

Plate 5

p 105



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wanting; but, in the recent subject, this large notch is divided into two distinct foramina by the sacro-ischiatic ligaments. These foramina serve for the transmission of various vessels, nerves and muscles which constitute the soft paries of the cavity of the pelvis.

Practical Remarks.

From the manner in which the bones of the pelvis are covered by the soft parts, they are so protected from external violence as to be seldom fractured: but the accident, when it does occur, is one of great danger, from the attendant injury to the viscera contained within the cavity formed by their union. Fracture of these bones is usually produced by the passage of some very heavy weight over the pelvis, or by a fall from a considerable height: and in both of these cases, there is generally such a contusion of the soft parts covering the bones as greatly to enhance the danger. The ossa pubis and ossa ischia are so protected by the lower extremities, as to be less liable than the ilia to solution of continuity; but, as may be seen in *Plate V*, the whole of them may be fractured, and even at the same time. The drawing of this plate was taken from a preparation in the Museum of Guy's Hospital. From the immobility of the broken parts upon each other, the diagnosis in this form of injury is frequently difficult; but the most ready mode of discovering a fracture of the ilium, is to place the palm of one hand with considerable force upon the dorsum, and with the other to grasp the crista of the bone at its upper part; when, on moving it inwards and outwards alternately, an indistinct crepitation may sometimes be felt. Such, however, is the immobility of these bones, and so thickly are they covered with muscle, that even when fractured we often fail to produce a crepitus. If fracture of the pubes be suspected, press your fingers upon the symphysis, then move the crista as before; when, if a fracture exist, a crepitus may be distinguished: and should the ischium be the supposed seat of injury, one hand is to be pressed firmly against the tuberosity, and the crista moved, as in the other cases, to detect the precise point of the separation. If, however, in consequence of the great tumefaction, these examinations should prove unsatisfactory, the inability of the patient to move the pelvis in the least degree, without experiencing considerable pain, will assist us in forming a diagnosis; and the pain, in such cases, is usually described as a grating sensation.

In the treatment, the point for consideration is not, as in fractures of bones in general, the means to be employed to keep the bones in apposition; for, as has already been noticed, they have little or no tendency to be displaced—our object must be, to apply such remedies as will obviate the effects of inflammation upon the loose cellular tissue contained within the pelvis. We ought, first of all, to pass a catheter, in order to ascertain whether or not the bladder or urethra have been injured. Should the result of our examination, and, perhaps, the flow of bloody urine, indicate such injury, the instrument ought to be allowed to remain to prevent extravasation. A broad belt should then be tightly applied round the pelvis, and the patient kept strictly in the recumbent posture. The better to secure this horizontal position, under all circumstances, a strong broad girth should be passed under the nates, the extremities of it being fastened to a pulley suspended from the top of the bed, so that the patient may be raised with the least possible effort to himself. Copious and repeated blood-letting should be had recourse to; and such topical remedies, as would be most likely to obviate the disastrous results of continued inflammatory action.

LECTURE IV.

THE BONES OF THE EXTREMITIES.

The extremities form the third division of the skeleton, and are composed of the *upper* and *lower extremities;* between which there is a considerable resemblance, as well in the number as in the relation of their several bones.

The *upper,* or *thoracic extremities,* are situated at the superior and lateral parts of the chest, being attached to the trunk by the articulation of the clavicle with the sternum; this articulation forming the fulcrum for the motions of the whole extremity. Several bones enter into the composition of the upper extremities, and are divided into those of the *shoulder, arm, fore arm,* and *hand.*

The Shoulder.

There are two bones which constitute the shoulder:—the *scapula,* a flat bone, situated at the posterior and lateral part of the chest; and the *clavicle,* a small cylindrical bone, placed at the upper and anterior part, and extending over the upper part of the first rib. This bone forms the line of separation between the neck and the chest: it is situated between the sternum and the scapula. On tracing it from the former to the latter bone, it is found to take a course from within to without, and from below slightly upwards, its scapular being rather posterior to its sternal end. In shape it somewhat resembles an italic *S,* projecting from the sternum, and forming a concavity in passing backwards to the scapula.

The clavicle is divided into its *body*, its *sternal* and *scapular extremities*, and its *tubercles*.

The *body* comprises the middle part of the bone, and presents a superior surface, which enlarges as it extends outwards: the sternal half of this surface is rounded and roughened, and gives attachment to the m. sterno-cleido-mastoideus. The inferior surface is similar in its form and direction: it is hollowed in its middle part, to lodge the subclavian muscle; and there is also seen here a foramen, for the passage of the nutritious vessel. The under surface of the body is placed between two projecting portions of bone termed the *tubercles*, which are situated at the precise point where the extremities of the clavicle are connected with the body. The inner tubercle is for the purpose of giving attachment to a ligament connecting this bone with the first rib; and the outer one, for the ligaments which join the clavicle with the coracoid process of the scapula. The anterior edge of the body is large: convex on its sternal half, where it gives attachment to the pectoralis major muscle, and concave on its outer half, to which is affixed the deltoid muscle. The posterior edge, on the contrary, is concave internally, and convex externally, where the m. trapezius is inserted.

The *sternal extremity* is the thickest part of the bone, and terminates in an articulatory surface, which is directed slightly forwards. This surface is somewhat triangular in form, being larger above than below, and is concave from behind to before. The circumference of this extremity of the bone is rough, for the attachment of ligaments to strengthen its articulation with the sternum. It should, however, be mentioned, that an intervening cartilage separates the clavicle from the sternum.

The *scapular extremity* is inclined backwards and upwards, to be connected to the acromion process of the scapula by a small *articular surface*, which has its long axis from before to behind. This extremity presents a *superior* and an *inferior, flattened, rough surface*, which give attachment to ligaments connecting the clavicle with the scapula.

Plate 6

p 107

Fig 1

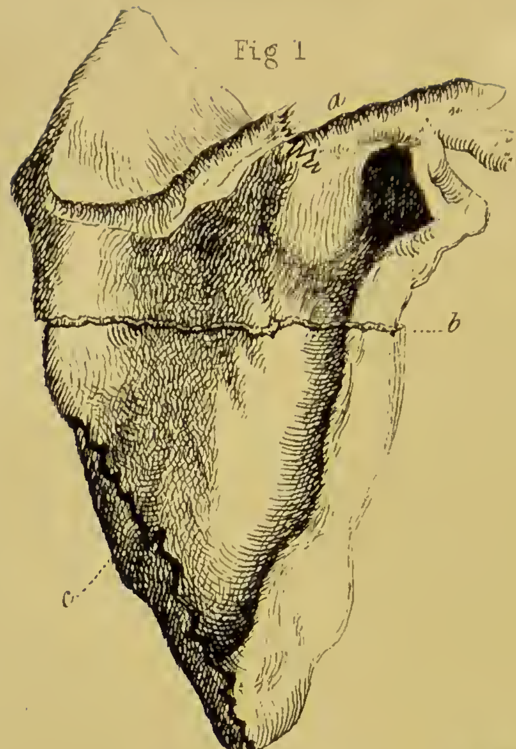

Fig 2.

Fig 3.

The *use* of the clavicles is to afford, through their articulation with the sternum, a fulcrum for the extensive motions of the upper extremities, and also to prevent the scapulæ from approaching each other, and falling upon the thorax: they also afford attachment to several muscles, and protection to the subclavian vessels.

Muscles attached to the clavicles are the m. pectoralis major, deltoides, and subclavius, beneath; and the trapezius, sterno-mastoideus, and sterno-hyoideus, above.

Practical Remarks.

There are many circumstances which render the clavicle liable to fracture, such as its length preponderating so much beyond its thickness; its being so little protected by soft parts: and, perhaps most of all, the manner in which it is placed between the scapula and sternum. From the joint influence of these circumstances, a fall upon the point of the shoulder, by driving the clavicle with great force against the sternum, causes the former bone to give way in its middle part.

In this accident the diagnostic marks are easy of detection, and invariable in their appearance. The external or scapular portion is that which is always displaced, being drawn downwards by the weight of the extremity to which it is attached, and leaving the inner or sternal portion in its natural situation. *(Vide Plate VI. Fig. 3.)* At first sight it is the inner portion which attracts attention, as it appears to protrude in consequence of the skin being drawn forcibly over its free extremity, by the descent of the outer portion of the bone. The patient loses the power of raising the hand on the injured side to the head; and if he attempt it, he only bends the fore arm, in consequence of the humerus having lost its fulcrum. The injured upper extremity approximates to the chest, whilst the width of shoulder is lost. Under these circumstances the surgeon should trace the clavicle along its whole extent, to discover the precise situation and direction of the fracture; and then, by raising and supporting the elbow, the scapula may be brought up to the sternal portion of the fractured bone, and crepitus felt.

Treatment.—Place a large firm pad in the axilla, raise the elbow, so as to elevate the outer portion of the bone to the inner, and keep it in that situation by a short, sling. In the next place, wind a long bandage round the chest, including in the folds the whole length of the upper arm of the injured limb; thus, you will keep the elbow close to the side, whilst the pad in the axilla will force the shoulder outwards, and prevent its tendency to fall upon the thorax.

In comminuted fractures of the clavicle, and in cases where the fracture extends with great obliquity, it may happen that the broken portions shall lacerate the skin, and render the fracture compound. It is also possible for the subclavian vessels to be injured. These circumstances would necessarily render the prognosis much less favourable. In simple cases, the bone usually consolidates in forty or fifty hours.

The Scapula.

This bone is situated at the upper posterior and lateral part of the chest, and together with the clavicle, through the medium of numerous muscles, serves to connect the upper extremity with the trunk. It is of a triangular form, and may be considered as one of the flat bones. This bone reaches from the first to the seventh rib, and is placed with a slight degree of obliquity, so that the inferior angle of the two scapulæ have a tendency to converge. The parts which are to be observed on the scapulæ are the following:—

Three *processes,*—the *acromion, coracoid,* and *spine:* —three *costæ,*—a *superior, posterior,* and *anterior,*—these terminating in *three angles,* a *superior, inferior,* and *anterior:* three *fossæ,*—the *fossæ supraspinata, fossa infraspinata,* and *fossa subscapularis.* Three *notches,*—the *acromial, semilunar,* and *coracoidal,* besides the *neck* and the *glenoid cavity.* The *external surface* of the bone is convex, and the *internal one* concave. Having thus named the several parts constituting the scapula, the particular description of each will be more readily understood.

I shall commence with the processes, and first, the *spinous process,* which runs across the dorsum or convex surface of the bone, passing from below upwards, and dividing this surface of the scapula into two unequal fossæ for the attachment of muscles. The spine then becomes broader; and, rising up above the body of the scapula, terminates in the *acromion process,* or extremity of the shoulder, which, overhanging the glenoid cavity, protects the shoulder-joint superiorly and behind. The *acromion* is hollow underneath, to allow of the passage of a muscle, and its extremity is tipped with cartilage to be connected with the clavicle. The *coracoid process* rises upwards from the neck of the scapula, passes forwards and inwards over the glenoid cavity, and assists the acromion in protecting the joint: it, also, gives attachment to muscles and ligaments. The *costæ* form the three sides of the triangle: the *superior one* is the shortest, and forms the base of the triangle. The *posterior costa*, or *base* of the scapula, as it is sometimes called, commences from the posterior termination of the superior costa, and passes downwards to terminate at the inferior angle of the bone: several muscles are attached to this part of the bone. The *anterior costa* is the edge of bone passing from the lower part of the glenoid cavity to the inferior angle, and forms the longest of the sides of the triangle: it gives origin to muscles.

The *angles* are produced at the points of junction of the three costæ. The *anterior* one forms the inferior point of the glenoid cavity, and gives attachment to the tendon of the long head of the triceps muscle. The *posterior angle* is formed by the termination of the superior costa and commencement of the posterior, and has the levator scapulæ muscle inserted into it. The *inferior* is the most acute of the three, and is produced by the termination and junction of the anterior and posterior costæ; the latissimus dorsi passes over it.

Of the *three fossæ* two are placed on the dorsum of the scapula, whilst the largest one forms the internal concavity of the bone. The *fossa supraspinata* is all that hollow above the spinous process, between it and the superior costa, and lodges the supraspinatus muscle. The *fossa infraspinata* forms the remaining portion of the dorsum of the bone below the spine, and lodges the infraspinatus muscle; while the whole of the cavity on the inner side or venter of the scapula constitutes the *fossa subscapularis*, so named from the muscle which arises from it. Two of the notches have reference to the fossæ—the *acromial* aud *coracoidal*. The *acromial notch*, situated between the junction of the two fossæ spinatæ and neck of the glenoid cavity, receives the tendons of the two spinati muscles in their passage to the humerus;

whilst the *coracoidal notch* is that extreme point of the fossa subscapularis, plaeed betwcen the base of the eoracoid process and edge of the glenoid eavity.

The *semilunar*, or proper notch of the seapula, is situated between the superior eosta and root of the eoracoid process; the noteh being formed in the recent subject into a foramen, by a ligament. The superior dorsal artery of the seapula passes above this ligament, whilst its eorresponding nerve passes beneath it and through the foramen.

The anterior eosta is surmounted by an artieulatory surfaee, whieh is termed the *glenoid* eavity. It is of an oval form, superfieial, and larger below than above. Its great diameter is vertieal, and it is slightly inelined outwards. The glenoid cavity is surrounded by a fibro-eartilaginous structure in the recent subjeet, whieh renders it deeper; and the upper part gives attachment to the long head of the biceps.

This cavity is eonneeted with the body of the scapula by a contracted portion of the bone, whieh is termed the *neck*. It is to be remembered that the true neek is only that portion of bone between the glenoid eavity and base of the coraeoid proeess; it is the portion whieh is roughened for the attachment of the eapsular ligament, and not, as is sometimes deseribed, the part posterior to the eoracoid process, ineluding the proper or posterior notch. The seapula is conneeted with the sternum and os hemeri.

The *use* of the scapula is, with the assistance of the clavicle, to serve as a fulcrum for the upper extremity; and, from its extent of motion, to present under every directiou of the arm, a convenient socket for the head of the os humeri to move in. The scapula also defends the posterior part of the thorax and its contents from external injury.

Muscles attached to the scapula are seventeen in number; and it may assist the memory to state, that seventeen distinct parts of the bone have already been described. Of the seventeen muscles six are inserted into the scapula, whilst eleven arise from it. Those *inserted* into it are m. levator scapulæ, into the superior angle; rhomboideus major, minor, and serratus anticus, into the whole length of its base or posterior costa; pectoralis minor into the caracoid process; and, lastly, the trapezius into the acromion and spinous processes. The eleven *arising* from it are, first, the m. omo hyoideus, from the superior costa close to the notch; from the under part of the spine and acromion process, the deltoides; from the three fossæ, the supra and infra spinati, and the subscapularis; the teretes and long head of the triceps, from the anterior costa: the coraco-brachialis and short head of the biceps, from the coracoid process, the long head ot the biceps from the apex or upper part of the glenoid cavity; and, lastly, the latissimus dorsi, in its passage over the inferior angle of the scapula, derives a small part of its origin from that portion of the bone.

Practical Remarks.

The scapula is a bone but little liable to fracture, as well from its situation as from its mobility. Nevertheless, under aggravated circumstances, fracture of this bone is occasionally met with; and more particularly in certain parts of it, from their greater comparative exposure: as, for instance, the acromion, inferior angle, superior angle, and coracoid process. Fractures, too, either longitudinal or transverse, may happen through the dorsum of the bone. Fracture of the acromion may be readily discovered, as the fractured portions are much displaced by the action of muscles. In this accident the roundness of the shoulder is lost, by the weight of the upper extremity and the action of the deltoid muscle drawing the point of the acromion downwards; while the trapezius and levator scapulæ, have a tendency to draw the scapula, and the remaining portion of the acromion, upwards and slightly backwards. The position of the two fractured portions may be seen in *Fig.* 1. *Plate VI.* When the inferior angle of the scapula is separated from the rest of the bone, the deformity which occurs renders the nature of the accident sufficiently obvious to be easily detected. The detached portion is drawn forwards by the inferior fibres of the serratus major anticus, and by the teres major, while the rest of the bone remains in its natural position: but the most conclusive diagnostic mark of this accident is, that, if the scapula be moved, the detached angle remains perfectly stationary. (*Vide a. Fig.* 2. *Plate VI.*) If the coracoid process be broken off, its extremity is drawn downwards by the coraco-brachialis and biceps muscles, and forwards by the pectoralis minor. The position of a fractured coracoid process is shewn in *Plate VI. Fig.* 2. *b.* In the transverse fractures through the dorsum scapulæ, there is also slight derangement of parts. If the fracture extend completely across the bone, the displacement is produced by the action of the serratus major anticus, which being strongest at its lower part, draws the inferior portion of the scapula forwards: so that by passing the finger along the posterior costa, an irregularity of surface may be felt. *(Vide Plate VI. Fig. 1. b.)* When fractures through the dorsum are vertical in their direction, but very slight derangement occurs, in consequence of both the external and internal surfaces of the scapula being so completely covered by muscles. *(Vide Plate VI. Fig. 1. c.)* In all cases of fracture of the scapula, great attention should be paid to the constitutional as well as to the local treatment, as the principal danger arises from the contusion of the soft parts necessarily attendant on a degree of violence sufficient to produce a fracture. Bleeding, purging, and the antiphlogistic regimen are to be strictly adhered to, to prevent the inflammation terminating in abscess, and, probably, subsequent exfoliation of bone. When the dorsum of the bone is fractured, the arm ought to be fixed to the side of the thorax by a long roller passed round the chest, enclosing the arm from the shoulder to the elbow, much in the same manner as the bandage directed to be applied in fracture of the ribs. But when the fracture is at the inferior angle, the arm is to be drawn across the fore part of the chest, and confined there, so as to bring the scapula towards the detached angle, which is itself too small to be acted upon.

In fractures of the acromion, the head of the humerus is to be forced upwards, and retained there so as to form a splint to the acromion. This may be accomplished by applying a bandage round the trunk and arm, and afterwards carrying it from the elbow to the shoulder for several turns, till it produces an effect similar to that of a short sling. This bandage must be worn for six weeks at least, as the acromion requires a considerable time for its consolidation. Lastly, in fractured coracoid process, the object is to relax the fibres of the coraco-brachialis biceps, and pectoralis minor; which is to be done by bringing the humerus forward, the scapula inwards, and bending the fore arm to a right angle, and fixing the whole in this position by bandages.

The Os Humeri.

The *humerus* is the largest bone of the upper extremity, situated between the scapula above, and the radius and ulna below. It is cylindrical in form, and is divided into its *body* and two *extremities*.

The upper *extremity* or *head* of the bone presents an articulatory surface, which forms about the third part of a sphere, and is directed upwards, backwards, and inwards, towards the glenoid cavity of the scapula, with which it is connected by ligaments, to form the shoulder-joint. Immediately around this articulatory surface, the bone is *rough*, for the attachment of the capsular ligament; and it is this point joining the head of the bone to the body, or shaft, which is to be considered the true anatomical *neck*. Just below the neck, on the upper anterior and outer part of the body of the humerus, is situated the *greater tubercle*, which is furnished with an outer, middle, and internal surface, for the attachment of three of the muscles of the shoulder-joint. To the inner side of this process we observe a smaller, which is termed the *lesser tubercle*, and which gives attachment to one muscle only. Between these two tubercles there is a deep *sulcus*, or *groove*, which is lined with cartilage, and receives the tendon of the long head of the biceps. This groove necessarily possesses two *edges*, both of which are rough, for the insertion of muscle. The *body*, or *shaft*, extends from the head of the humerus to its condyles, and forms by far the greatest part of the length of the bone; if divided into thirds, the upper third will be found rounded, the middle third twisted, and the lower one flattened. It may also be observed, that the upper third is smooth posteriorly, allowing the triceps muscle to pass over it, but without being attached to it; while anteriorly on this portion of the bone two lines may be seen proceeding from the outer and inner tubercles, to terminate at the condyles. The groove for lodging the tendon of the biceps, is also situated on this part of the bone. The middle third presents a contorted appearance, as if the head of the bone and the condyles had been twisted in opposite directions half round, so as to produce this singular effect. Two *rough surfaces* are seen on this portion of the bone for the attachment of muscle: an *outer* one for the insertion of the deltoid, and an *inner* one for the insertion of the coraco-brachialis. A *foramen* for the nutritious artery is also found in this region, the direction of which is from above to below. The lower third of the humerus is flattened, and increases in breadth as it descends to terminate in the condyles. It offers an *anterior* and a *posterior* flattened surface, and two *lateral ridges*. The anterior surface is somewhat roughened for the attachment of the brachialis internus muscle, and presents, immediately above the internal condyle, rather to the inner side of the centre of the bone, a deep *depression*, to receive the coronoid process of the ulna during a flexed state of the fore arm. This depression is sufficiently deep to allow flexion of the arm to a very acute angle. The *posterior surface* is smooth, allowing the passage of the triceps muscle over it, but not giving origin to it; and, at the lower part, immediately above the condyles, in the middle line of the bone, is situated a *deep depression*, which lodges the olecranon process of the ulna, during extension. The olecranon is so large and projecting, as not to allow extension beyond the straight line. The lateral ridges are continuations of the two lines leading from the greater and lesser tubercles above, and which were before described as terminating at the condyles. They are for the purpose of giving attachment to muscles of the elbow and wrist-joints. The inferior extremity forms the external and internal *condyles*, the former giving origin to the extensor, and the latter to the flexor muscles of the hand and fingers. The external condyle presents below a *rounded articulatory surface*, well adapted to allow of the two-fold motions of the radius: namely, the flexion of the elbow-joint, and the revolution of the radius upon the ulna. Just on the outer side of this surface is a small projecting *non-articular apophysis*, which gives attachment to muscles and ligaments. The internal condyle is larger, and very different in its form. Like the external, it is covered with cartilage, and presents a *pulley-like articulatory surface*, which is called the *trochlea*, on which the sigmoid cavity of the ulna moves in flexion and extension. Both the condyles present a larger articulatory surface anteriorly than posteriorly, which admits of a greater extent of flexion than of extension of the fore arm. The internal condyle is also furnished with a non-articular apophysis on its inner side, which is much more projecting than the outer one, but serves a similar purpose in giving attachment to muscles and ligaments.

The os humeri is *connected* above with the scapula, and below with the radius and ulna, entering into the composition of the shoulder and elbow-joints: indeed, it may be considered to assist also in forming the superior radio-ulnar articulation, as none of the motions of that joint can take place without the radius rolling on the external condyle.

The *muscles* attached to the humerus are those of the shoulder-joint, which are inserted into it, and several of the muscles of the elbow, wrist, and fingers, which have their origin from it, amounting in all, to twenty-four. Beginning at the upper extremity of the bone, there are inserted into the greater tubercle three muscles, viz. the m. supra-spinatus, infra-spinatus, and teres minor: into the lesser tubercle, one only, the sub-scapularis. Into the edges of the bicipital groove, three muscles: one, the pectoralis major, into the outer, or anterior edge, and two into the inner edge, viz. the latissimus dorsi and teres major. The whole of the posterior part of the bone is covered by the triceps muscle, and two of its heads arise from the humerus itself: the second begins to be attached immediately below the outer and back part of the greater tubercle, extending downwards in connexion with the line reaching from that process to the external condyle. The third head arises just where the internal ridge of the bicipital groove is lost in the substance of the bone. About the middle of the bone, on its outer side, is inserted the deltoid muscle, and just to the inner side of this, the coraco-brachialis. The junction of the middle with the lower third of the bone anteriorly gives origin to the brachialis internus. The internal condyle gives origin to the pronator radii teres of the radio-ulnar articulations, to the flexor carpi radialis, palmaris longus and flexor carpi ulnaris of the wrist-joint, and to the flexor sublimis perforatus and flexor longus pollicis muscles of the fingers. The external condyle has arising from it the m. anconeus of the elbow joint, the supinator radii longus and brevis of the radio-ulnar articulations, the extensor-carpi radialis longior and brevior, and the extensor carpi ulnaris of the wrist-joint, and, lastly, the extensor digitorum communis of the fingers.

Practical Remarks.

The humerus may be fractured in any part of its length; but in consequence of the diversified actions of the muscles attached to it, the position of the displaced portions of the bone will vary according to the situation of the fracture. It therefore becomes highly important to consider each fracture separately. The humerus may be fractured through its neck, within the capsular ligament; it may be fractured just below its tubercles, above the insertion of the pectoralis major, latissimus dorsi, and teres major: or in the space between those muscles, and the insertion of the deltoid: or below the deltoid muscle: or, lastly, through the condyles of the bone.

When the fracture is through the neck, and consequently above the tubercle of the bone,—an accident, however, of rare occurrence,—but little deformity takes place; the bone being retained in nearly its natural situation by the capsular ligament. The shaft of the bone is nevertheless drawn slightly upwards and outwards; the rotundity of the shoulder remains, and crepitus may be readily felt in consequense of the proximity of the fractured surfaces: for the capsular ligament not being torn, little separation can take place. *(Vide Plate VII. Fig. 1.)* The treatment proper for the accident is to confine the arm in a short sling, to place a pad in the axilla, and to apply pressure on the greater tubercle by means of a compress and bandage, so adjusted as to press the upper extremity of the shaft against the head of the bone, which remains in its natural position within the glenoid cavity.

The injury next to be described has, by some surgeons, been called fracture of the *neck* of the bone. The situation alluded to, however, is immediately below the tubercles of the os humeri, above the insertion of the muscles attached to the edges of the bicipital groove, which cannot certainly with propriety, be regarded as the *anatomieal* neck of the bone. I would designate the accident, therefore, *fracture immediately below the tubercles.* At first sight the position of the arm might lead the surgeon to suppose that the deformity depended upon a dislocation of the head of the bone into the axilla; but attention to the following circumstances will generally enable us to form a correct diagnosis. The roundness of the point of the shoulder remains: a hollow is observed below the point, in consequence of the lower fractured portion, or shaft, being drawn inwards by the action of the pectoralis major, latissimus dorsi, and teres major, whilst the deformity is increased by the action of the teres minor and spinati muscles drawing the upper portion of the fractured bone upwards, outwards, and backwards: no tumor is to be felt in the axilla: the whole limb is moveable, so that a very slight force readily restores it to its natural position; but this force is no sooner withdrawn, than the deformity returns: lastly, the patient experiences the same difficulty in raising the hand to the head, as occurs in fracture of the clavicle, a difficulty in both cases arising from a loss of the fulcrum, upon which the upper extremity plays. The treatment is much the same as in fracture of the clavicle. A large conical pad should be placed, with its base upwards, in the axilla, and the arm

Plate. 7.

p. 116.

J. Basire lithog

confined to the chest by a bandage, including the extremity from the shoulder to the elbow. Four splints ought also to be applied to the arm, in order to prevent displacement by the action of the muscles. *(Vide Fig. 2. Plate VII.)*

When the fracture occurs in the space between the insertion of the latissimus dorsi, pectoralis major, and teres major, and the attachment of the deltoid muscle, the position of the fractured portions is very different from that accident last described. In this case, the lower part of the bone is drawn upwards and outwards by the action of the deltoid, so as to form a perceptible tumour on the outer side of the arm ; and the deformity is increased, if the fracture be oblique, by the action of the pectoralis major and latissimus dorsi, which draw the upper portion of the bone inwards. *(Vide b. Fig. 3. Plate VII.)*

Extension and counter-extension having been made to adapt the fractured surfaces, they are to be retained in apposition by splints and bandages, and by confining the arm close to the trunk, so as to relax those muscles which have a tendency to displace the fractured surfaces of the bone.

If the humerus be broken below the deltoid muscle, at the flat portion of the bone, but little deformity follows, in consequence of the extent of attachment of the brachialis muscle on the fore part, and the triceps behind, which, by their combined action serve as a kind of splint to the bone. *(Vide c. Fig. 3. Plate VII.)* Nevertheless, should the bone, even in this situation, be broken with great obliquity, a greater degree of displacement occurs than when the fracture is transverse: but in both cases the lower fractured portion of bone is drawn slightly forward. This accident is often mistaken for dislocation of the radius and ulna, in consequence of the deformity being nearly the same in both ; but the diagnosis is rendered clear, by making extension, when all the signs of dislocation immediately disappear. The treatment in this accident is to bend the fore arm to a right angle, and to maintain it in that situation by pasteboard splints ; at the same time keeping the elbow-joint constantly moistened with evaporating lotions.

The condyles of the humerus are sometimes separated from the rest of the bone: this accident most frequently happens to the internal condyle, from its great projection of tubercle, and the little protection afforded it by soft parts. *(Vide d. Fig. 3. Plate VII.)* It usually occurs at an early age. From the condyle being drawn backwards, it appears as if the ulna were the bone displaced : but the nature of the injury may be distinguished, by the ulnar resuming its natural situation on extension being made, and also by a crepitus, which is very readily detected. The treatment consists in applying a roller around the joints, in bending the fore arm, and maintaining the broken portion of the bone in its natural situation, by means of wetted pasteboards. Passive motion should be employed, after the lapse of three weeks, to counteract any disposition to anchylosis.

When the external condyle is fractured, swelling, inability to perform the motions of the elbow-joint, and crepitus, are the diagnostic marks. Here the crepitus is most perceptible when the patient is desired to attempt the rotatory motions of the hand. When a large portion of the condyle is broken off, it is drawn somewhat upwards and backwards. The treatment is the same as in fracture of the internal condyle. Pasteboard splints best answer the purpose in these accidents.

The Fore-Arm

Forms the third division of the superior extremity, and is composed of two bones, the radius and the ulna.

The Radius.

The *radius* is shorter than the ulna by a length equal to that of the olecranon; it is placed on the outer side of the arm, is continued on the same line with the humerus, and reaches from the elbow to the wrist-joint. It is of a cylindrical form, and is divided into a *body, neck, tubercle,* and *two extremities.* The *upper extremity,* or *head,* presents a rounded cup-formed articulatory surface, which is covered with cartilage, and receives the external condyle of the humerus, thus entering into the composition of the elbow-joint. This cavity is surrounded by a projecting lip of bone, which presents upon its inner side a cartilaginous surface, having its long axis and convexity from before to behind, and is received into the smaller sigmoid cavity of the ulna, thereby producing the superior radio-ulnar articulation. Immediately below the head, the bone becomes contracted, forming the *neck,* which is rounded and smooth, to allow the bone to move readily within the coronary ligament. Just below the neck, on the inner and fore part of the bone, is placed the *tubercle,* a projecting rough surface of bone, for the tendinous insertion of the biceps muscle. Below this process is the *body,* which extends to the lower extremity, and forms the greatest part of the length of the bone. It is of a triangular form, and presents *three surfaces* and *three angles*. The *anterior surface* is somewhat hollow above, expanding in its lateral dimensions as it descends, and becoming flattened for the attachment of the pronator quadratus muscle. On this surface is to be observed the *foramen* for the nutritious artery, having its course from below upwards. The *posterior surface* presents a convexity outwards and a concavity inwards, which are more particularly distinct in the middle third of the bone. The concavity offers an extended surface for the attachment of the muscles of the thumb. The lower third of this surface is grooved for the passage of the tendons which are attached to the fingers. The *external surface* is arched, and offers nothing remarkable, excepting a *rough surface* in its centre, for the insertion of the pronator radii teres muscle. Of the *angles*, the *internal* is the most acute, and gives attachment to the interosseous ligament: it forms a very considerable arch, the concavity of which faces inwards, thereby producing a space between it and the ulna for the lodgement of muscles. The *external* angle is rounded, presenting no particular point worthy of observation. The *posterior angle* is only to be remarked in the lower two-thirds of the bone, and forms a ridge between the posterior superficial and deep layer of muscles.

The *inferior extremity* of the radius is the largest part of the bone, and is divided into an *anterior* and a *posterior surface*, two *articulatory surfaces*, and a *process*. The anterior surface is concave from side to side, allowing of the passage of the flexor tendons to the fingers. The posterior surface forms a general convexity from side to side, but is rendered irregular by four grooves, which pass from above to below, and which admit of the passage of the following tendons: the outer groove receives the tendons of m. primi et secundi internodii; the second groove, the extensor carpi radialis longior et brevior; the third, the extensor tertii internodii; while the fourth and inner one transmits tendons of the indicator and extensor digitorum communis. On the outer side of the inferior extremity of the radius, between the first and second described grooves, is situated the process which is termed the *styloid*, and which gives attachment to the external lateral ligament of the wrist-joint. On the inner side an *articulatory surface* is found, with a concavity passing from before to behind, which serves to receive the lower extremity of the ulna: it is termed the *smaller scaphoid cavity* of the radius. The inferior extremity of the bone forms the larger *articulatory surface*, which has its long axis from side to side, its con-concavity from before to behind, and is called the *greater scaphoid cavity*. It is covered with cartilage, and divided into two unequal portions by a *ridge*, which passes from before backwards. The outer part articulates with the os scaphoides, and the inner with the lunar bone, for the formation of the wrist-joint.

The radius is *connected* above, with the humerus; below, with the scaphoid and lunar bones; and on its inner side, by a double articulation, with the ulna.

Muscles attached to the radius are eight: four of which, employed in the radio-ulnar articulation, are inserted into that bone, viz.:—the m. supinator radii longus and brevis, pronator radii teres, and pronator quadratus, and one muscle of the elbow-joint, the biceps: whilst the three which arise from it are muscles of the fingers, viz.:—the flexor sublimis digitorum, flexor longus pollicis, and extensor primi internodii.

The Ulna.

This is the longer of the two bones of the fore arm: it is situated on the inner side, is larger above than it is below, and is divided, like the radius, into a *body* and *two extremities*.

The *superior*, or *humeral extremity*, which is the largest part of the bone, is very irregular in its form, and composed principally of two *large processes*, and two *articulatory surfaces*. The larger of the processes is termed the *olecranon*: it forms the superior and posterior portion of the bone, and gives to it the length which it possesses beyond the radius. This process is rough above, for the attachment of the triceps muscle. Behind it forms a triangular surface, which is merely covered with skin, and may be easily felt in the living subject. Anteriorly, it is concave, covered with cartilage, and forms a portion of the articulatory cavity which receives the internal condyle of the humerus. The smaller *anterior process* is termed the *coronoid:* it is situated below as well as before the olecranon, and is directed from the upper part of the ulna forwards, and slightly upwards. Its posterior surface is concave, and, in the recent subject, covered with a cartilage continuous with that lining the olecranon; thus, together, completing the *greater sigmoid cavity,* which receives the trochlea of the humerus. This cavity is divided by a ridge, passing from the upper part of the olecranon, to the top of the coronoid process, into two unequal portions, the inner of which is the larger. Immediately on the outer edge of the coronoid process is found the *smaller sigmoid cavity,* which is hollowed from before to behind, and receives the inner articular surface of the head of the radius. The inner edge of the coronoid process is sharp, and roughened, for the attachment of muscles and ligaments; while, anteriorly and below, it terminates in a roughened *tubercle,* to which is attached the tendon of the brachialis internus muscle. The *body* of the ulna is triangular, and presents an *anterior,* a *posterior,* and an *internal surface:* also an *external,* an *anterior,* and a *posterior angle.*

The *anterior surface* is concave throughout its whole length, to lodge the numerous muscles situated between it and the radius. The lower part of this surface is somewhat flattened and rough, for the origin of the pronator quadratus. In its upper third may be seen the nutritious foramen, which takes its course from below upwards. The *posterior surface* is divided by a line which passes from the posterior edge of the smaller sigmoid cavity through the whole length of the bone, and gives insertion to some of the muscles of the elbow-joint, and origin to those of the fingers. The *internal surface* is broad and concave above, where it is covered by muscles; while the lower third becomes contracted, and is placed immediately under the skin, where it may be readily distinguished in the living subject. Of the *three angles*, which separate the described surfaces from each other, the *external* is the most projecting, especially in its middle part, and gives attachment to the interosseous ligament. The *anterior angle* is more obtuse, and particularly so above, where it gives attachment to the deep flexor muscle common to the fingers; while below it is sharper, for the origin of the pronator quadratus. The *posterior angle* commences immediately below the triangular surface of the olecranon: it is at first very marked, but below is lost imperceptibly in the substance of the bone, which there becomes rounded. Above, it gives attachment to the intermuscular tendon, which affords a common origin to the flexor and extensor carpi ulnaris, and the flexor profundus digitorum muscles.

The inferior or carpal extremity of the ulna, is much smaller than the superior; is rounded in form, but rendered irregular on its inner side by a projecting conical process, which is termed the *styloid*, the extremity of which gives attachment to the internal lateral ligament of the radio carpal articulation.

The outer part of the inferior extremity is round, and is named the *head* of the ulna: inferiorly, it is covered with cartilage, where it is contiguous with the interarticular cartilage of the wrist-joint, which separates it from the cuneiform bone. Externally, it also forms an articular surface to be connected with the radius, forming the inferior radio-ulnar articulation. Anteriorly, the head of the ulna is rough, for the attachment of ligament. Posteriorly, a deep groove separates the styloid process from the outer portion of the head, for the passage of the tendon of the extensor carpi ulnaris muscle.

Use.—The ulna is articulated with the humerus, these two bones nearly completing the elbow-joint; the radius having but little office in the functions of that articulation. It is also connected above with the

Fig. 1.

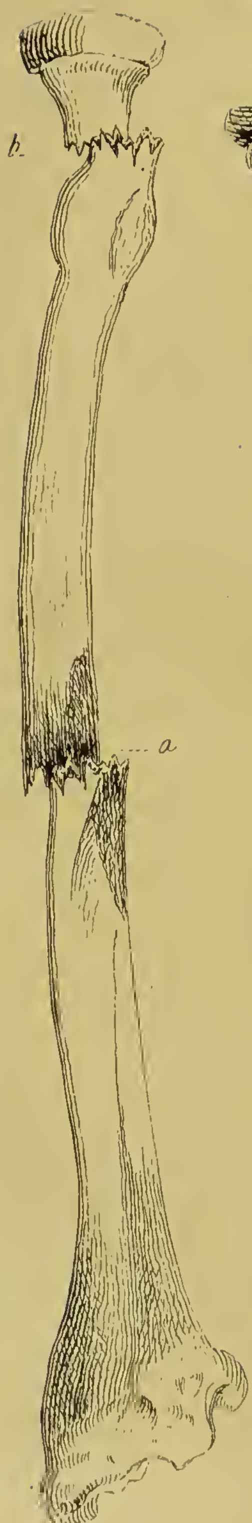

Fig. 2.

Fig 3.

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radius, which it receives in forming the superior radio-ulnar articulation: and below, it forms the inferior radio-ulnar articulation, by being received by the radius. It has no connexion with the wrist-joint, being separated from it by the upper surface of the interarticular cartilage.

Attachment of Muscles.—Fifteen muscles are attached to the ulna. Three of the elbow-joint are inserted into it:—the brachialis internus, the anconeus, and the triceps. Of the radio-ulnar articulations, three muscles arise from the ulna:—the m. supinator radii brevis, the m. pronator radii teres, and the m. pronator quadratus. Of the wrist-joint, the muscles arising from the ulna are—the m. flexor carpi ulnaris and radialis, and the extensor carpi ulnaris. Of the fingers, the m. flexor communis sublimis et profundus, digitorum, extensor primi secundi et tertii, internodii pollicis, and indicator.

Practical Remarks.

Fractures of the Fore-Arm.—Of the two bones, the radius is much more frequently broken, in consequence of its being attached to the hand, and placed in a direct line with the humerus; from which circumstance, in a fall, the hand being naturally put forward, the whole weight of the body is communicated to the radius, this bone is driven forcibly against the humerus, and not unfrequently gives way at its middle part. Pain, a loss of power in effecting the motions of pronation and supination of the hand, and a crepitus which may be readily felt in producing these rotatory motions, form the diagnostic marks of the nature of the accident. Under these circumstances, the position of the fractured portions is such as to form a salient angle inwards, towards the ulna—a disposition of parts produced by the action of the pronator muscles: *(Vide a. Fig.* 1., *Plate VIII.)* and therefore rendering the space between the two bones of the fore-arm much less, and projecting the muscles from between them. When the radius is fractured through its neck, the diagnosis is more difficult, in consequence of the thick covering this part of the bone receives from numerous muscles; and the nature of the accident is further obscured by the difficulty in producing crepitus. This difficulty occurs from the position of the fractured portions of the bone, the inferior being drawn upwards, inwards, and forwards, by the action of the biceps muscle, while the head and fractured neck of the bone, are drawn slightly outwards by the supinator radii brevis. *(Vide b. Fig.* 1., *Plate VIII.)*

In fractures of the radius, the hand is constantly proned.

Fractures of the Ulna.—The ulna is less liable to fracture than the radius, from circumstances already mentioned. The accident usually occurs from the application of a force applied immediately upon the fractured part, and most frequently at its lower extremity, in consequence of the bone there being smaller and less defended by soft parts. By passing the fingers along the internal surface of the bone, an irregularity will be felt at the point of fracture, in consequence of the lower portion of the fractured bone being drawn outwards, towards the radius, by the pronator quadratus muscle. *(Vide a. Fig.* 2., *Plate VIII.)* The superior portion of the ulna remains fixed.

Fractures of the Olecranon.—Occasionally the olecranon is separated from the ulna, and it is said sometimes to occur from the inordinate action of the triceps muscle; but it must more frequently happen from a fall upon the point of the elbow. When this accident occurs, the olecranon is drawn upwards above the condyles of the humerus, by the action of the triceps muscle, so that a hollow is found at the posterior part of the elbow-joint, instead of the prominence which this process forms when in its natural position. The degree of separation of the fractured olecranon from the ulna, being increased and diminished by flexion and extension of the elbow-joint, is a further diagnostic mark, and renders the nature of the accident sufficiently obvious. However, when the fracture has occurred from any great degree of violence, the contusion and swelling may render the diagnosis more difficult. But these concomitant circumstances should not perplex the surgeon, as the treatment should be immediately directed against the inflammation, as if the fracture did not exist, until it be sufficiently subdued to discover the extent of injury.

The treatment to be followed in fracture of the olecranon, (of which I shall now treat, as it differs from that followed in all the other accidents to the bones of the fore-arm), consists in placing the fore-arm in a perfectly extended position; and by gradually drawing down the triceps muscle, the fractured olecranon may be brought into contact with the upper part of the ulna: it may be retained in this situation by a stellate bandage passing above and below the elbow, and should be continued along the whole length of the humerus, so as to diminish the irritability of the muscles. The anterior hollow of the elbow should be filled with lint, and a long splint should be applied over it, to maintain the extended position of the limb, which is essential to the reparation of the bone.

Fracture of both Bones of the Fore-Arm—When this accident happens, it usually occurs either from a heavy weight passing over the arm, or from a violent blow; and in either case the bones are usually fractured on the same level. A fall can hardly produce fracture of both bones at once, as the radius receives the whole weight of the body.

The diagnosis in this accident may be formed from the following indications:—pain, loss of motion, particularly as to pronation and supination of the hand, and by a crepitus being perceptible in producing rotatory motion. The arm has also a rounded appearance, as if tumefied, in consequence of the protrusion of the muscles from the interosseous space. In this accident there is but very little shortening of the limb.

Treatment.—Place the hand between supination and pronation, and slightly directed towards the ulna; semiflex the fore-arm, and then, while making gentle extension and counter-extension, push back the protruded muscles between the bones, keeping them in that situation by placing a well adjusted pad on the fore and back part of the arm, reaching from the elbow to the wrist: over these apply splints, which are to be retained by three or four pieces of tape—not a bandage, as it would tend to thrust the broken bones towards each other, and again diminish the interosseous space. Then place the fore arm in a sling, and allow the hand to hang down, so that a constant extension of the limb may be kept up, which very materially assists in retaining the fractured ends of the bones in their proper situation. The principal point is to preserve the natural extent of the interosseous space; for if this be diminished, the rotatory motion of the radius must be imperfect. The treatment when only one of the bones is broken, differs in no respect from that recommended for fractures of both bones; excepting, perhaps, it may be considered worthy of notice, that in fracture of the lower part of the radius, the hand should be bent more inwards towards the ulna, and permanently retained in that position during the progress of cure.

The Hand.

The bones of the *hand* form the last division of the upper extremity, and comprehend all the parts from the joint of the wrist to the points of the fingers. It presents a convexity posteriorly, to give strength, and a concavity before, for the purpose of enabling it to grasp substances. The hand is capable of a considerable extent of motion, in flexion and extension, but of a slight degree in a lateral direction.

The bones of the hand are subdivided into those of the *carpus, metacarpus,* and *phalanges.*

The Carpus.

The superior part of the hand is formed of eight small bones, disposed in two rows, each consisting of four bones:

the upper called the *cubital row,* consisting of the *scaphoid, lunar, cuneiform,* and *pisiform* bones. The lower, or *digital row,* consisting of *trapezium, trapezoides, magnum,* and *unciform* bones.

The os scaphoides is situated most externally of the cubital row, and immediately to its inner side is placed the lunar bone; both of them present superior rounded articular surfaces, to be connected with the radius, by which junction a very considerable portion of the wrist-joint is formed. The cuneiform bone is placed immediately on the inner side of the lunar, but does not extend so high as either of the last two bones. It is not in contact with either the radius or the ulna, being opposed to the under surface of the interarticular cartilage, which, together with this bone, completes the wrist-joint, and separates the ulna from that articulation. The cuneiform bone forms the inner or ulnad termination of the cubital row of the carpus; the fourth bone of this range, viz., the pisiform, being situated on its anterior surface, reaching into the palm of the hand.

Of the digital row, the os trapezium is the most external or radial, and is situated between the os scaphoides and the first phalanx of the thumb: the trapezoid is placed on the inner side of the trapezium, between it and the os magnum, being connected, above, with the scaphoid, and below, with the metacarpal bone of the fore finger. Immediately on its inner side is found the os magnum, bounded, above, by the scaphoid and lunar bones; below, by the metacarpal bones of the middle, fore, and ring fingers; and lastly, to the inner or ulnad side of this row, is situated the unciform bone, having the cuneiform bone above, and the ring and little finger below it.

The ossa scaphoides and trapezium on the outer side, and the pisiform and hamillary process of the os unciforme on the inner side, present four prominences in the concave anterior surface of the carpus, which give attachment to the annular ligament, for the purpose of confining the tendons of the flexor muscles, and maintaining the lateral arch of the wrist.

The bones of the carpus present such peculiarities, as to render it necessary to give to each a separate description; and, according to the usual plan, I shall begin with the scaphoid bone, which is placed on the radial side of the cubital row of the carpus.

Cubital Row.

Os Scaphoides.

This bone is so named from its resemblance to a boat, and is articulated, above, with the radius; below, with the magnum; on the outer side, with the trapezium and trapezoid; and on its inner side, with the lunar bone. It therefore presents five *articulatory surfaces.* The upper surface is convex from within to without, and from before to behind, corresponding to the outer concave articular surface, on the inferior extremity of the radius.

The lower concave surface has its long axis from side to side, for the purpose of receiving a part of the rounded head of the os magnum, on the inner side of which is a crescentic, flattened, articular surface for the lunar bone.

The outer articular surface is placed obliquely, facing outwards and downwards; is divided by an indistinct ridge, to be connected with the trapezium and trapezoid bones.

The posterior, or dorsal surface of this bone, is marked by a deep groove, having a direction from within to without, which gives attachment to ligament.

The anterior, or palmar surface, is also rough for the insertion of ligament; and being less expanded than the posterior, assists in forming the carpal arch.

Use.—This bone enters into the composition of the wrist-joint, above, and the articulation, between the two rows of the carpus, below.

The scaphoid bone does not give attachment to any muscle.

Os Lunare.

The os lunare has received its name from its crescentic form, and presents, like the scaphoid bone, an upper rounded articular surface, to complete the articulation between the carpus and the radius. Below, this bone is concave from behind to before, to receive the inner surface of the head of the os magnum. The inner side presents a large flattened articular surface, for the cuneiform bone; and at the angle formed by these two last-named surfaces, is situated the apex of the unciform bone. The outer side is connected with the os scaphoides, by a flattened semilunar articulation. The dorsal and palmar surfaces of this bone are rough, for the attachment of ligament.

Use.—The os lunare assists in completing the wrist-joint, as well as the carpal articulations.

This bone does not receive the attachment of any muscle.

Os Cuneiforme.

The cuneiform bone has derived its name from its wedge-like form, and is situated on the ulnar side of the cubital row of the carpus. It presents a superior flattened articular surface, to connect it with the lunar bone; an outer, somewhat concave surface, for its attachment to the unciform bone; a rounded surface anteriorly, for the pisiform bone; and a convex one, placed superiorly and internally, which corresponds to the under surface of the interarticular cartilage, separating the bone from the ulna. This bone also presents an internal, a palmar, and a dorsal non-articular surface, rough for the attachment of ligament.

Use.—The cuneiform bone, by its junction with the interarticular cartilage, completes the wrist-joint.

This bone does not receive the attachment of any muscles.

Os Pisiforme.

From its rounded figure, sometimes called the os orbiculare. It is placed in front of the cuneiform bone, with which it is connected by its only articular surface; this surface being flat and placed posteriorly. In front, this bone is irregularly rounded and roughened, for the attachment of the lateral ligament.

Use.—From its position in front of the carpus, it completes the transverse carpal arch; and thus protects the vessels, nerves, and tendons, in their passage to the fingers.

Attachment of Muscles.—This bone receives the insertion of the flexor carpi ulnaris, and gives origin to the abductor minimi digiti. The ligamentum carpi ulnare is also attached to it.

The Digital Row.

The four bones of the digital row are placed in the following order, beginning from the radial side: the *trapezium, trapezoides, magnum,* and *unciform.*

Os Trapezium.

The os trapezium is irregular in its form, but somewhat resembles the mathematical figure from which it has derived its name: it presents *four articular,* and *two non-articular* surfaces.

The *superior surface* forms a slight concavity, to connect it with the scaphoid bone.

Its *inferior,* or *digital surface,* is sharp, and terminates rather to its inner side in a small articular face, which is lengthened from before to behind, and receives a part of the metacarpal bone of the fore finger.

Its *outer articular surface,* which is the largest, is concave from above to below, and convex from before to behind; and is articulated with the first phalanx of the thumb.

Internally, it is connected with the trapezoid bone, and presents, therefore, an articular surface for that purpose.

Its *anterior,* or *palmar non-articular* surface, is rough for the attachment of ligaments, and has a deep groove traversing it from without to within, and from above to below, for the passage of the m. flexor, carpi radialis.

Its *dorsal surface* is rough, slightly hollowed, and gives attachment to ligaments.

Use.—This bone differs from the rest of the digital row of the carpus, in forming part of a very moveable articulation, which allows the thumb to turn in every direction upon it, while the others admit of but little motion of their respective metacarpal bones.

Attachment of Muscles.—The flexor and extensor ossis metacarpi pollicis, flexor brevis abductor pollicis, and abductor indicis, are connected with the trapezium.

Os Trapezoides.

This bone is somewhat of the same figure as that last described: it is situated immediately to the ulnar side of the os trapezium, and, like it, presents *four articular*, and *two non-articular surfaces.*

Its *superior articular surface* is somewhat concave, and is connected with the scaphoid bone.

Its *inferior*, or *digital surface*, is divided into two articular faces, by a central ridge, which is received into the superior carpal extremity of the metacarpal bone of the fore finger.

The *internal*, or *ulnar surface*, presents a triangular articular face, which is in contact with the os magnum.

Its *external*, or *radial surface*, is connected with the trapezium, and is less than that by which this bone forms a junction with the os magnum. Of the two non-articular surfaces, the *dorsal* is the larger, and has its long axis placed obliquely from before to behind, and is rough for the attachment of the dorsal ligaments of the hand.

The *smaller palmar surface* is also rough for the attachment of ligaments: it is so deeply seated in the palm of the hand, as to be concealed by the os trapezium.

Use.—This bone, besides assisting in the formation of the carpus, also supports the middle part of the metacarpal bone of the fore finger.

Attachment of Muscles.—The only muscle attached to the os trapezoides, is part of the flexor brevis pollicis.

Os Magnum.

The os magnum is so named from its being the largest bone of the carpus, and is situated in the middle of the digital row.

Its *superior*, or *cubital surface*, forms a rounded articular apophysis, which is termed its *head*, and which is received into the articular cavity formed by the scaphoides, lunare, and unciform bones. The head is attached to the body of the bone, by a contracted portion which may be termed its *neck*.

Its *base*, or *inferior digital surface*, is somewhat triangular, and presents three articulatory divisions, the middle of which is much the largest, to receive the whole of the metacarpal bone of the middle finger; while the metacarpal bone of the fore and ring fingers rest on the lateral divisions.

Its *outer surface* presents two articulatory faces, the upper convex, for the scaphoid bone, and the inferior, of an irregular form, for the trapezoid bone.

Its *ulnar side* is principally formed of a large flattened superior surface, which is connected with the os unciforme; and below this, a small portion of the articulatory surface, for the metacarpal bone of the ring finger, presents itself.

Two *non-articular surfaces* may also be described on this bone: the large posterior, or *dorsal surface*, rough for the attachment of the dorso-carpal ligaments; and its anterior, or *palmar surface*, narrowed to assist in forming the lateral arch of the carpus, for the passage of the flexor tendons of the wrist and fingers.

Use.—This bone enters principally into the formation of the carpal joint, and assists in supporting three of the metacarpal bones.

Attachment of Muscles.—The flexor brevis pollicis is the only muscle attached to the os magnum.

Os Unciforme.

This bone supports the metacarpal bones of the fourth and fifth fingers, and is situated between the magnum and cuneiform bones: it is somewhat of a triangular form, the *base* being placed below and the *apex* above.

The *base*, or *digital surface*, is covered with cartilage, and divided into two nearly equal-sized articulatory portions, by a ridge; these are slightly concave from before to behind, and receive the metacarpal bones of the fourth and fifth fingers.

The *apex, upper*, or *cubital surface,* forms an acute angle, which is covered with cartilage, to form an articulation with the os lunare; this junction being produced by the unciform bone wedging itself in between the magnum and cuneiform bones.

Its *radial*, or *outer surface,* is slightly convex; partly covered with cartilage, to connect it with the os magnum, and partly rough for the attachment of ligament.

Its *inner*, or *ulnar surface,* presents an articulatory face, which is concave from below upwards, for its junction with the cuneiform bone.

The *dorsal surface* of this bone, which is non-articular, is convex, and roughened for the attachment of ligaments.

The *palmar surface* is less than the dorsal, and is peculiar in having projecting forwards from it the *hook-like process,* from which the bone is sometimes named. This process is slightly curved, presenting a concavity towards the thumb, and a convexity inwards. It advances considerably into the palm of the hand, and gives a firm origin to the strong ligament which ties down the tendons of the wrist and fingers.

Attachment of Muscles.—Part of the flexor brevis pollicis. The flexor brevis, and abductor minimi digiti, arise from the unciform bone.

Practical Remarks.

Such is the description of the individual bones entering into the composition of the carpus: they are, however, so connected with each other, and with other bones, that they ought rather to be considered in the light of a compound whole, than as parts possessing individual uses; or in other words, they present, when taken collectively, an excellent illustration of that division of bones which we have already distinguished by the term "irregular." With little or no motion between themselves, they form, by their union with each other, a strong bony arch, which, whilst it imparts great strength, affords protection to important structures, and moreover presents an extensive, though an irregular, articulatory surface, to admit of the varied movements of the hand upon the radius. In appreciating the use of the carpal bones, taken collectively, it may perhaps be objected that the os trapezium offers an exception, inasmuch as that bone forms a direct articulation with the thumb, and admits of extensive motion: this must, indeed, be admitted, but the exception is readily accounted for, the trapezium being the only carpal bone directly connected with a digital phalanx; for I am disposed to contend, with some French anatomists, that the formation, connexion, and functions of that joint, all tend to prove that what is commonly, I believe, erroneously called the metacarpal bone, ought more properly to be regarded as the first phalanx of the thumb.

The Metacarpal Bones.

These are usually described as consisting of five in number; but in consequence of the thumb being articulated with the carpus, in a manner quite peculiar to itself, we may with propriety consider the thumb as being formed of three phalanges, while the remaining fingers have intervening between them and the carpus, the four metacarpal bones. When entering into further detail of the functions of the hand, in my lecture on the skeleton, other reasons will be adduced for the propriety of this arrangement.

The four metacarpal bones form the second division of the bones of the hand, and are situated between the wrist and the fingers. They resemble each other in being cylindrical, consisting of a *body* and two *extremities;* the *superior, upper,* or *carpal extremity,* being termed the *base,* is flattened and covered with cartilage, for their attachment to the carpus, and rough anteriorly and posteriorly, for the insertion of the carpo-metacarpal ligaments. The *inferior,* or *digital extremities,* are convex from before to behind, and flattened laterally, thus constituting the *head* which is covered with cartilage: where the head of the bone is connected to the body, it is contracted, forming the *neck,* which is bounded in its circumference by small rough tubercles, for the attachment of the metacarpo phalangeal ligaments: — while the intervening portion of bone, termed the *body,* is broad on its dorsal surface, concave on its palmar aspect, and flattened laterally; but although they much resemble one another, each presents certain peculiarities requiring individual description.

Metacarpal Bone of the Fore Finger.

This is the longest of the metacarpal bones, and may be also known from the others by its *upper extremity,* or *base,* presenting a deep *sulcus,* by whieh it articulates with the trapezoid bone, separating an *outer articulatory surface* for the trapezium, from a *smaller one* on the inner side, for the magnum: the *ulnar side* of the base offers a flattened surface, whieh is in eontact with the metaearpal bone of the middle finger. All these artieulatory surfaees are covered by a eontinuous eartilage. Upon the *palmar surface* of the base, there is a roughness for the insertion of the m. flexor carpi radialis. The *dorsal* and outer surfaee of the base, is marked by the insertion of the m. extensor earpi radialis longior. On the ulnar surface of the head is a small *tubercle,* for the attachment of the outer metaearpal ligament, eonneeting it with the metacarpal bone of the middle finger. The *body* of this bone is triangular, eoncave on its ulnar side only, for the lodgement of the prior indieis muscle.

Metacarpal Bone of the Middle Finger.

The *base* is situated obliquely, and forms one *articular surface* only, to be eonneeted to the magnum. On either side the base of the bone is covered with eartilage, where it is in contaet with the metaearpal bones of the index and ring fingers. The *dorsal surface* is broad and rough for the attachment of ligaments, and furnished with a tubercle for the insertion of the m. extensor earpi radialis brevior. Its *palmar* surfaee is very eontraeted, thus tending to produee the transverse areh of the hand. The *head* and *body* of this bone do not require any further deseription. The adduetor pollieis musele arises from this bone.

Metacarpal Bone of the Ring Finger.

The *base* of this bone is small, but presents four artieulatory surfaees: two above, a *large inner one* to be eonnected to the unciforme, and a small *ridge* to join it with the magnum. It is connected with the middle finger on its outer, and with the little finger on its inner side. The *body* of this bone is narrower than any of the other metacarpal bones.

Metacarpal Bone of the Little Finger.

Its *carpal articulatory surface,* for its attachment to the unciform bone, is convex from before to behind, and concave from side to side: the *radial aspect* has an articulatory surface for the metacarpal bone of the ring finger, while its *ulnar surface* projects a little beyond the unciform bone, and is roughened for the insertion of the extensor carpi ulnaris, and origin of the abductor minimi digiti. The *radial* side of the head of this bone only presents a tubercle, for the attachment of the intermetacarpal ligament.

The Fingers.

The fingers, which are composed of fifteen small bones, termed the phalanges, comprehend the third division of the bones of the hand.

Each finger is furnished with three of these bones, and in all, that phalanx nearest to the metacarpal bone is the largest, the inferior the smallest, while the middle are intermediate in size. All the phalanges have their superior or metacarpal extremity larger than the inferior, excepting in the first phalanx of the thumb, in which the inferior offers greater dimensions than its superior extremity. Their dorsal surfaces are convex and their palmar concave.

The Superior, or Metacarpal Phalanges.

These five bones differ but little from each other, excepting in size and length. Their *superior extremity,* which is the largest, presents an *oval articular surface,* having its long axis from side to side, and being concave from behind to before, to be articulated with the rounded extremity of the metacarpal bones. On each side of this articular surface, is situated a small *tubercle* for the attachment of the lateral ligaments. Their *inferior extremity* is terminated by two small condyles, separated from each other by a shallow groove: these condyles present a larger anterior than posterior articular surface, and are connected with their corresponding middle phalanges. The *bodies*, or middle parts of these bones, are concave on their palmar surface, and lodge the tendons of the flexor muscles of the fingers. Their *dorsal surface* is convex, and is covered by the extensor tendons: on each side are placed the digital arteries and nerves, and fibrous sheaths, which are attached to the tendons of the flexor and extensor muscles. The upper phalanx of the thumb differs, however, somewhat from this description, in having its superior extremity less than any of the other corresponding bonès, and being, indeed, smaller than at its inferior end; its superior articular surface also differs in being concave from before to behind, and convex from side to side, for its articulation with the os trapezium. Indeed, this bone is described by most anatomists as the metacarpal bone of the thumb, and that the thumb has only two phalanges; but the motion which this bone enjoys, when contrasted with the fixed position of the metacarpal bones, the consideration of its ligaments, and the insertion of the muscles into it, which are destined to move the thumb,—all these circumstances sufficiently shew the propriety of classing it amongst the phalanges, rather than the metacarpal bones.

The Middle Phalanges

Differ but little from each other, excepting in length; that of the middle finger being the longest, and of the little finger, the shortest and thinnest. Their *superior extremity* presents two small concave articular surfaces, separated from each other by a slight ridge, which prolongs itself into a process upon the dorsal surface and overlaps their articulation with the first phalanx. This extremity is rough on each side for the attachment of lateral ligaments, to strengthen their junction.

Their *inferior extremity* is precisely similar to those of the first phalanges: these phalanges have inserted into them the m. flexor sublimis.

The Inferior Phalanges

Only differ in size, that of the thumb being the largest, and of the little finger the smallest; their *superior extremity* are similar to those of the second phalanges. Their *inferior extremity* is rounded, is not furnished with any articular surface, is very rough, and larger than the *body* of the bone, it is convex upon its posterior surface, and covered with the nail; concave anteriorly, and gives attachment to the flexor profundus muscle.

Attachment of Muscles to the Metacarpus.—These muscles may be classed into those which are common to all; and those which are proper to individual bones of the metacarpus. The first class comprises the seven m. interossei. Of the second class, to the metacarpal bone of the fore finger; anteriorly, the m. flexor carpi radialis, posteriorly, the m. extensor carpi radialis longior are attached; to that of the middle finger, the m. extensor carpi radialis brevior, and the m. adductor pollicis; and to that of the little finger, the m. extensor carpi ulnaris, and the adductor minimi digiti.

Attachment of Muscles to the Phalanges.—These muscles may also be divided into those which are common and those which are proper to some of the fingers.

Those which are common, and which are inserted into all the fingers excepting the thumb, are the m. lumbricales into the upper or first phalanges; the m. flexor sublimis perforatus into the second phalanges; and the m. profundus perforans into the third phalanges; while the extensor digitorum communis is inserted into the dorsal surface of them all by a tendinous expansion, which receives also the attachment of the interossei.

The Muscles proper to the Thumb are eight, viz.:—three flexors, flexor ossis metacarpi (which would be better named the flexor primi internodii), into the first phalanx; the flexor brevis pollicis, or secundi internodii, into the second phalanx; and the flexor longus pollicis, or tertii internodii, into the third phalanx:—these are inserted into their palmar surface. Into their dorsal surface is inserted the extensor ossis metacarpi, or primi internodii, into the first; the extensor secundi internodii into the second; and the extensor tertii internodii into the third phalanx.

The abductor and adductor muscles proper to the thumb are inserted, through the medium of the ossa sesamoidea, into the joint between the first and second phalanges.

The Muscles proper to the Fore-Finger are two:—the m. extensor indicis into the dorsal surface of the two last phalanges; and the abductor indicis into the outer and back part of the first bone of the fore-finger.

The Muscles proper to the Little Finger are three;—the m. flexor brevis minimi digiti, and abductor minimi digiti, into the root of the first phalanx; and the adductor minimi digiti into the metacarpal bone supporting this finger.

Practical Remarks.

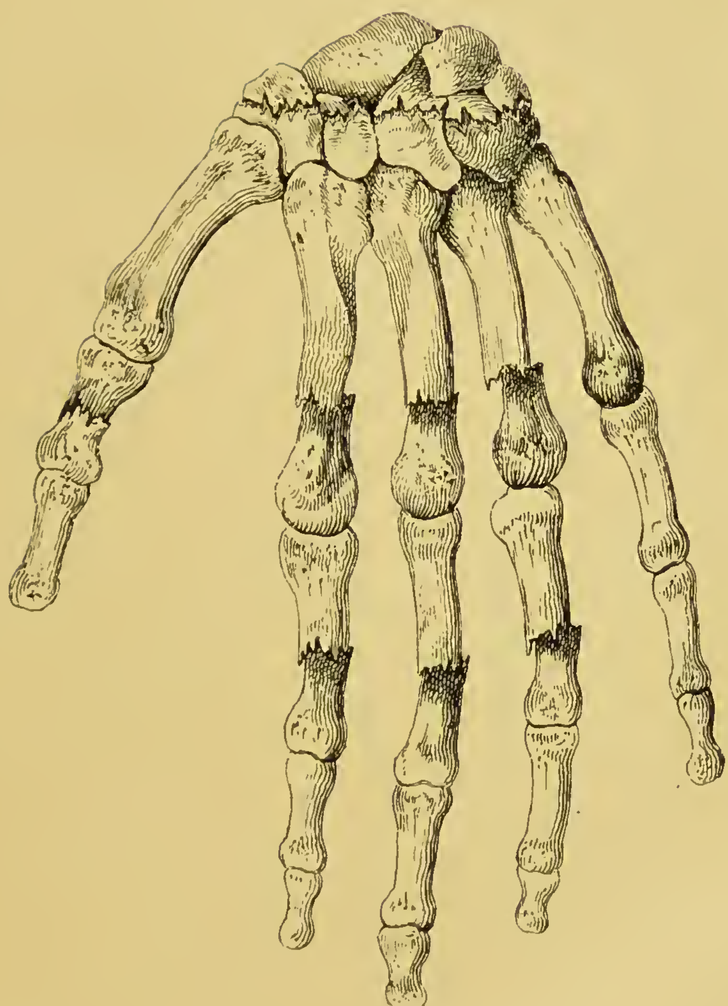
The fractures to which the bones of the hand are liable, may be considered as they may occur either to the carpus, metacarpus, or phalanges.

Fractures of the Bones of the Carpus.—This division of the hand is composed, as has already been described, of eight small bones, which are so closely articulated with one another, each presenting so small a surface and so spongy a texture, as rarely to admit of fracture, unless indeed it be occasioned by the application of some very heavy weight, when comminuted fracture of several of the bones may take place, attended consequently with considerable injury to the soft parts, so as frequently to render amputation necessary. A gun-shot wound, or the application of any concentrated force upon one of the bones of the carpus only, might produce solution of its continuity, in which case the treatment would consist of removing the comminuted pieces of bone, and poulticing as in common cases of gun-shot wound.

Fractures of the Bones of the Metacarpus.—These bones are more liable to fracture than those of the carpus, in consequence of their greater comparative length, as well as of their compacter structure. It is an accident which does not unfrequently occur to pugilists. When a metacarpal bone is fractured, the broken extremities of the bone are drawn slightly forwards into the palm of the hand, by the interossei muscles. The treatment consists in placing a ball in the injured hand, and drawing the fingers tightly over its surface, and retaining them in that position by bandages; the hand at the same time being kept at rest in a sling.

Fractures of the Phalanges.—From the manner in which these bones are articulated at the extremity of the hand, they are liable to fracture only from the immediate application of any force upon them; and therefore considerable contusion of the soft parts is a necessary concomitant. The fractured extremities of the bones are drawn forwards and slightly outwards, by the action of the flexor muscles; the deformity of the finger, the unnatural mobility of the bone, and crepitation, render the nature of the accident obvious. The treatment consists in extending the finger, in

Plate. 9.



J. Basire lithog.

the application of paste-board splints and roller, and the hand being confined in a sling. It may further be observed, however, that when the extreme phalanx is broken, from the small size of that bone, as well as from its having the nail and its ungual gland connected with it, it is better at once to amputate than attempt to save it, as the process of reparation in this accident is always tedious and uncertain.

The Lower Extremities.

The bones of the lower extremities are connected with the inferior part of the trunk, and are divided into the *thigh*, *leg*, and *foot*.

The Os Femoris.

This bone alone forms the thigh; is the longest and heaviest bone in the body, being situated between the bones of the pelvis and the tibia. It is divided into *head*, *neck*, *body*, and *condyles*. The *head*, which forms its articulatory surface for its attachment to the bones of the pelvis, is of a rounded form, and directed inwards and slightly forwards, forming about three fourths of the segment of a circle. It is every where covered with cartilage, excepting a small fossa placed upon its inner and upper part, to which the ligamentum teres is connected to the bone itself. The outer circumference of the head is encircled by a rough line, marking the precise point of demarkation between the head and neck; this edge giving the inner attachment to the capsular ligament. From this point the *neck* proceeds downwards and outwards to the body of the bone, at an angle varying with the age of the individual, and at the adult period of life is about 45°. It is more slender where attached to the head of the bone: it is somewhat triangular in its form, presents a plane surface anteriorly, and is concave on its other aspects. It is roughened, for the firmer attachment of the capsular ligament; and penetrated with foramina, for the transmission of vessels into the cancellated structure. The neck of the bone, where attached to the shaft, expands itself so as to produce *two processes:* the upper and outer one, termed the *trochanter major*, projects upwards, so as, in some measure, to rise above the neck, and is directed slightly backwards. It presents a convex external surface, divided into a smooth upper and a rough lower half; the upper smooth surface marking the situation of a bursa for the insertion of the m. gluteus medius et minimus. Internally the trochanter major is hollowed by a deep fossa, for the attachment of the rotator muscles of the thigh outwards. Posteriorly the trochanter major terminates by a rough line, which is directed downwards, backwards and inwards, and terminates in a rounded tubercle denominated the *trochanter minor*. This rough line receives the insertion of the m. quadratus femoris, and attachment to the capsular ligament, is called the *linea quadrata*. The trochanter minor is rounded, faces inwards and downwards, and appears equally to terminate the inferior line of the neck of the bone as it does the linea quadrata. It is hollowed anteriorly, for the insertion of the m. psoas magnus and iliacus internus; while it is roughened posteriorly, forming a part of the *linea aspera*.

The *body* or shaft forms the longest portion of the bone, and is situated between the trochanters and condyles: it presents an anterior smooth convex surface, over which passes the extensor muscles of the knee-joint. The sides of the shaft of the bone are flattened for the attachment of the vasti muscles, and are bounded by an acute edge on the inner, and an obtuse edge on the outer side, which pass backwards, to meet in a single line to form a part of the linea aspera, which is situated on the posterior part of the bone. The posterior surface is concave from above to below, for the lodgement of the flexor muscles of the knee-joint, and is distinctly divided into a superior, middle, and inferior third. The superior third is somewhat flattened, and presents two lines proceeding from the trochanters: these lines meet in the middle third, and form, with the angles of the sides of the bone, the linea aspera. When in the lower third they again separate, to terminate in the two condyles, At the junction of the upper with the middle third, on this surface of the bone, a foramen is seen for the transmission of the nutritious artery, the direction of which is from below upwards: and at the junction of the middle with the lower third, the inner crus of the linea aspera presents a groove, marking the situation where the femoral becomes popliteal artery.

The inferior extremity of the bone is expanded, forming two large articulatory surfaces, which are termed the *external* and *internal condyles.* These articulatory surfaces meet anteriorly, to form a pulley-like articulatory depression for the patella ; this surface being covered with cartilage continuous with the two condyles. Inferiorly the condyles diverge ; the external presenting a rounded articulatory surface, convex from behind to before, and slightly from side to side, with its outer more prominent than its inner edge. The internal condyle is necessarily longer than the external, from the obliquity with which the bone descends to come in contact with the tibia : it is more contracted and convex from side to side than the outer condyle, and has a longer axis from before to behind. The articular cartilage, which covers the condyles, projects further posteriorly than anteriorly. A deep cleft separates the two condyles from each other posteriorly, to lodge and protect the popliteal vessels and nerves. The *non-articular* or *lateral surfaces* on the two condyles are flattened and rough for the attachment of ligaments, also allowing the vasti muscles to pass over them, to be inserted into the patella. A *tubercle* is seen posterior to the central axis of the condyles, for the attachment of the lateral ligaments ; and behind the tubercle, upon the inner condyle, is a pit, for the tendon of the adductor magnus muscle ; and on the outer condyle, a fossa which lodges the m. popliteus, when the knee is flexed. The *inferior extremity* of the bone is perforated by a number of vessels passing into the interior. This bone assists in forming the hip and knee-joints.

Attachment of Muscles.—The gluteus, medius, et minimus are inserted into the trochanter major: from the posterior part of which process a rough line marks the insertion of the m. gluteus maximus. Into the deep pit upon the inner and back part of the trochanter major is inserted the m. pyriformis, geminus, superior and inferior, obturator externus and internus: and into the line between the trochanters, the m. quadratus femoris. Into the fore part of the trochanter minor are inserted the m. psoas magnus and iliacus internus: into a rough line, passing from the trochanter minor, is inserted the pectinæus: these three last muscles being flexors of the hip-joint. Into the whole length of the inner edge of the linea aspera, the three heads of the m. triceps adductor femoris are inserted. The upper and fore part of the shaft of the bone gives origin to the m. cruræus, while the m. vasti arise on either side from the linea aspera: this line also posteriorly, in its lower third, gives origin to the short head of the m. biceps, flexor, cruris. From both condyles the m. gastrocnemius externus arises; and from the external condyle also the m. popliteus and plantaris. Thus it may be observed, that the thigh-bone receives the insertion of all the muscles of the hip-joint, and gives origin to some of those of the knee and ancle.

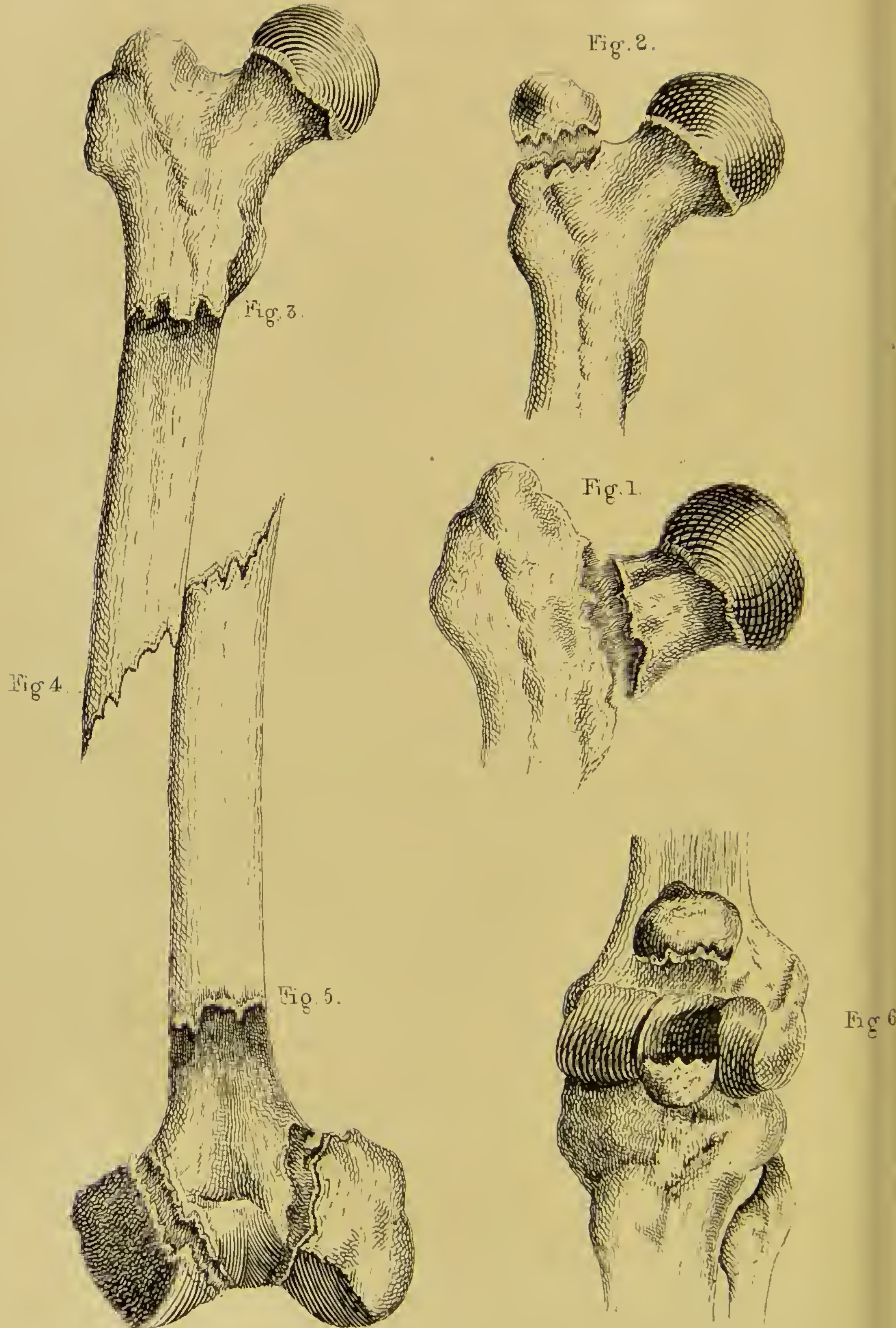
Practical Remarks.

Notwithstanding the great strength of this bone, still, as may be said of every cylindrical bone, it is liable to fracture in any part of its extent, either at the point of immediate application of a force, or it may give way in its centre, from a fall on the condyles; in which case the upper part of the bone forms the point d'appui, and the natural curvature of the bone has a tendency to be increased beyond its power of extension, and it necessarily yields. In consequence of the numerous muscles which are attached to this bone, it is obvious that the fractured extremities must vary in their direction, depending upon the influence of muscular power, and the precise point at which the femur is fractured; therefore we will consider individually those particular parts of the bone, which, when fractured, invariably take a certain direction.

Fracture of the Neck.—(Vide Fig. 1., Plate IX).—It is unnecessary for me to offer any remarks upon the different opinions which surgical writers have entertained, concerning the union or non-union of this fracture. The diagnosis is always sufficiently distinct to point out the nature of the injury: first, this accident only occurs at an advanced period of life; the limb is shortened and everted; slight extension brings it to its natural length; and rotatory motion during extension

Plate 10.

p. 143



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produces crepitation. The only accident for which this can be mistaken, is dislocation upon the pubes; but the circumstance of the one being unnaturally fixed, while the other is capable of inordinate motion, will lead to a just knowledge of the injury. From the experience I have had upon this subject, I feel I cannot do better than recommend the practice adopted by Sir Astley Cooper, as laid down in his work on fractures and dislocations.

The Trochanter Major (Vide Fig. 2., Plate IX.) is sometimes detached from the shaft of the bone;—an accident which it is difficult to detect, in consequence of the small size of the separated portion, and from its not producing any alteration in the direction or length of the limb; the fractured portion of bone being drawn up by the action of the m. gluteus medius and minimus, a considerable separation frequently occurs. In consequence of these two muscles being wholly inserted into the trochanter major, the adaptation of the fractured extremity is difficult both to produce and to maintain; and can only be accomplished by the abduction of the injured limb, in addition to the other ordinary means. I have had an opportunity of witnessing this accident, and experienced all the difficulties I have described.

Fractures immediately below the Trochanter Minor.—(Vide Fig. 3., Plate IX.)—This accident differs from all other fractures of the thigh, excepting that last described, from the greater displacement occurring in the upper than the lower portion of the bone, in consequence of the insertion of the m. psoas magnus and iliacus internus the upper fractured extremity is drawn forwards, so as to form a tumour in the groin, which deformity can only be obviated by bending the pelvis upon the thigh, so that the patient must be placed in bed nearly in a sitting posture.

Fracture in the Middle of the Shaft.—(Vide Fig. 4., Plate IX.)—When this portion of the bone is fractured, a shortening of the limb invariably takes place, which is produced by the action of those muscles which are attached to the whole length of the thigh-bone. The most usual position of the fractured extremities is, for the lower portion to be drawn upwards and inwards by the adductor muscles, while the upper is thrown outwards, forming in this situation a perceptible protuberance produced by the action of the m. gluteus maximus. This is not, however, the invariable direction; for if the fracture occurs midway between the insertion of the m. gluteus maximus and the external condyle, the m. vastus externus will draw both portions in such a direction as to form a salient angle outwards, in which case very little shortening occurs.

Transverse Fracture immediately above the Condyles.—(Vide Fig. 5., Plate IX.)—In this case, the m. gastrocnemius externus plantaris and popliteus, draw downwards and backwards the inferior portion of the bone, so that the inferior extremity of the upper part appears to be the one displaced.

In Fractures of the Condyles, the vasti muscles passing around them to be inserted into the patella, admit of but little displacement. They have a slight tendency to be drawn backwards by the m. gastrocnemius externus, and the inner one upwards by the tendon of the m. adductor magnus.

Fractures of the Thigh may be considered of more difficult management than that of any other bone, both in consequence of the difficulty in keeping the parts in apposition, and of the violence necessary to produce solution of continuity.

In all fractures, the causes of the displacement of the fractured portions of bone is muscle; and as coaptation is necessary for the cure, it becomes the object of the surgeon to place the limb in that situation best adapted mechanically to prevent the influence of muscles, as well as to subdue their irritability by constitutional means. For the first indication various apparatus have been invented, aud numerous positions of the fractured limb recommended. It occurs to me, however, that no general practice, no constant rule can be laid down as the best. The surgeon's mind in every case can alone form the means to be adopted, as applicable to the individual instance; bearing in mind that coaptation must not only be produced, but preserved for a longer or shorter period. From the size of the femur, its reparation is not completed, under ordinary circumstances, in less than fifty days.

The second division of the bones of the lower extremity, or leg, is composed of the *tibia, patella,* and *fibula.*

The Tibia

Is the largest bone of the leg, placed on the inner side, entering into the composition of the knee and ancle-joints, and is situated between the femur and tarsus. It is divided into a *body,* and *two extremities.*

The *superior extremity,* or *head,* is of an irregular oval form, having its long axis from side to side, with a convex anterior and a concave posterior edge, or circumference. Its upper surface presents two *articulatory faces,* an external and an internal one, to receive the corresponding condyles of the femur, which they resemble somewhat in form, the *internal one* being oval from behind to before, and deeper than the *external one,* which is nearly circular. These two articulatory cavities are separated from each other by a *spine* in the centre, and by a roughened cavity behind and before. The spine is bifid, and has a pit placed between its projecting points; their summits are covered with the cartilage of the articular cavities of the tibia. The roughened *cavities,* anterior and posterior to the spine, give attachment to the ligaments of the semilunar cartilages, and to the crucial ligaments.

The *circumference* of the head of the tibia, below the articulatory surfaces, is rough for the attachment of the ligaments of the knee-joint, and presents an *anterior,* a *posterior,* and *two lateral regions.* The *anterior region* is flattened and triangular, having a smooth surface for the ligament of the patella to play over it. The two lateral boundaries of the head form what are termed the *tuberosities* of the tibia: the *internal* one is larger than the external, and upon it may be observed, at the posterior part, an impression to receive the insertion of the m. semimembranosus. The *external* tuberosity forms the greater part of a circle than the internal one, although of a smaller circle; and upon its posterior part is situated a small, convex, rounded, *articular surface,* facing downwards, backwards, and slightly outwards, for the attachment of the fibula. The tuberosities on either side, just posterior to the long axis of the head of the tibia, are marked for the attachment of the lateral ligaments of the knee-joint. The *body* of the tibia begins immediately below the head of the bone: it diminishes in size as it passes downwards, as far as the junction of the middle with its lower third; and at that point it increases again in size, to enlarge itself into its lower extremity. The body is of a triangular form, and presents an *internal,* an *external,* and a *posterior face;* an *anterior,* an *internal,* and an *external angle.*

The *internal face* is smooth and convex in all its length, excepting just at at its upper part, where it is broadest; and there it is somewhat roughened, concave, and is covered by the tendons of the m. sartorius gracilis and semitendinosus muscles. The rest of the internal surface is only covered by skin and fascia, and terminates below in forming the inner projecting portion of the inferior extremity.

The *outer face* presents less surface than the internal; is concave on its upper half, and convex below, where it becomes directed more forwards than outwards. The upper broader concave part gives origin to the m. tibialis anticus and extensor longus digitorum; the lower third is covered by the tendons of those muscles, as well as of the extensor proprius pollicis and peroneus tertius.

Its *posterior surface* may be considered as the largest of the three, and is marked above by an *oblique line,* which begins immediately below the articular face on the outer tuberosity for the fibula, and proceeds downwards and inwards, to terminate at the inner angle of the bone, leaving a triangular space above it, for the attachment of the popliteus muscle; whilst this line gives attachment also to the soleus tibialis posticus and flexor longus digitorum, which cover the posterior surface of the tibia. Just beneath the linea poplitea is found the canal, for the nutritious artery of the bone, which takes its direction from above to below.

The *three angles* of the tibia separate these surfaces from each other.

The *anterior angle* is also called the spine of the tibia: it begins above from the *anterior tuberosity* of the tibia, and proceeds downwards to the inferior extremity of the bone,—not, however, in a straight course, but so as to produce a sigmoid line, presenting a concavity outwards for its upper and inwards for its lower half. The *anterior tuberosity,* from whence this line begins, gives attachment to the ligamentum patellæ, while the line itself has attached to it the fascia of the leg.

The *internal angle* begins from the roughness on the inner tuberosity of the tibia, for the insertion of the internal lateral ligament, and proceeds downwards the whole length of the bone to the inferior extremity: above, it is obtuse and rounded;

below, it becomes more acute. The superior third gives attachment in part to the popliteus muscle, and internal lateral ligament of the knee-joint; to the rest of its extent, the common flexor of the toes is attached.

The *external angle* is the sharpest of the three, and gives attachment to the interosseous ligament.

The *inferior* or *tarsal extremity*, is smaller than the superior; but, like it, is furnished with an articular surface. This portion of the bone is somewhat quadrilateral, and has distinguished upon it, therefore, an *anterior*, a *posterior*, an *external*, and an *internal aspect*. *Anteriorly*, it presents a roughened transverse line, to which is attached ligamentous fibres to strengthen the ancle-joint. *Posteriorly*, it is very similar in form, and in the same manner roughened: it is furnished with a groove, which is directed from above to below, for the passage of the tendon of the flexor proprius pollicis.

Internally, the inferior extremity projects downwards, beyond the rest of the base, and forms a large protuberance, which is termed the *malleolus internus*. This process is convex and seabrous on its inner surface, to give attachment to ligament: on its outer, or fibular face, it is concave from before to behind, and covered with cartilage to be connected with the astragalus. *Anteriorly*, it is sharp and rough, for the connexion of ligament. *Posteriorly*, it is grooved, for the passage of the tendon of the tibialis posticus muscle.

The *outer*, or *fibular aspect* of the tarsal extremity of the tibia, presents a triangular articular surface, which is concave from before to behind, and forms, by its junction with the fibula, the inferior tibio-fibular articulation. This surface is placed in a line posterior to the articular surface, for the superior articulation of the fibula.

The *articular surface* for the astragalus, which forms the inferior extremity of the tibia, is of a square form, concave from behind to before, and deeper on its inner than its outer side: it is covered with cartilage continuous with that which lines the fibular aspect of the malleolus internus.

Use.—The tibia assists in forming four articulations, viz.:—the knee, the ancle, and the superior and inferior tibio-fibular articulations; besides giving attachment to numerous muscles.

Attachment of Muscles.—Through the medium of the ligamentum patellæ, the rectus cruralis and two vasti muscles are inserted into the anterior tuberosity; into the posterior part of the internal tuberosity, the m. semimembranosus; into the upper part of the inner face of the body, the m. sartorius gracilis and semitendinosus are inserted. To the outer face are attached the m. tibialis anticus, and extensor longus digitorum; and the popliteus, soleus, tibialis posticus, and flexor longus digitorum, are attached to the posterior face of the tibia.

The Patella.

This bone may be considered as the largest sesamoid bone in the body, being suspended between the tendon of the extensor triceps cruris and the ligamentum patellæ. It bears also considerable analogy to the olecranon; the only difference being that the olecranon is attached by bone to the ulna, while the patella is fixed to the tibia by tendon only.

The patella is irregularly triangular, and is so situated at the anterior part of the knee-joint, as to have its *base* above, and its *apex* below. It also presents an *anterior* and a *posterior surface.*

Its *anterior surface* is convex, rough and striated, as if marked by the fibres of the tendon of the extensor muscles. It is also perforated with foramina for the passage of blood vessels.

Its *posterior surface* is smooth and covered with cartilage, but is divided into two distinct articulatory surfaces by a middle convex ridge; these surfaces corresponding to the condyles of the femur, the external one being the larger and rounded, by which the right patella may be known from the left. The circumference of the patella is rough, for the attachment of the synovial membrane of the knee-joint.

The *base*, or superior edge, is flattened, and has inserted into it the extensor tendon.

The *apex* is pointed, and gives attachment to the ligamentum patellæ.

Use.—The patella serves to protect the knee from injury, and also gives attachment to the extensor muscles of the leg.

The Fibula

Is situated on the outer side of the leg, is of the same length as the tibia, but is much more slender: it is so situated, with respect to the tibia, as to be placed behind its level.

This bone is divided into its *body* and *two extremities.*

Its *upper extremity,* or *head,* is of an irregular form, but somewhat rounded, and presents an articular surface, which is concave from behind to before, faces upwards, inwards, and forwards, to be articulated with the external tuberosity of the tibia. Immediately posterior to this surface, a *process* of bone rises up of a pyramidal form, which serves to strengthen and protect the superior tibio-fibular articulation. The circumference of the head of the fibula is rough, for the attachment of ligaments, and also for the tendon of the biceps flexor cruris muscle.

The *body* is twisted and irregular in form, but is somewhat triangular; and is bent with a slight curve outwards. Like the tibia, the body of this bone may be described as possessing three *faces* and three *angles:* the faces distinguished as an *external,* an *internal,* and a *posterior;* and into an *external, internal,* and *anterior* angle.

The *external face* is twisted, so as above to be directed forwards, and below backwards: it is somewhat hollowed in its upper third, where it gives attachment to the two peronei muscles.

The *internal face* is also twisted, but in a contrary direction to the last; so that above it is directed backwards, and below forwards: the centre of this face is hollowed out, to lodge the muscles situated between the tibia and fibula in front. It also gives attachment to the extensor longus digitorum, and the extensor proprius pollicis.

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The *posterior face* is less twisted than the other two, and is more convex. It is roughened above for the origin of the soleus muscle, and below it gives attachment to the flexor longus pollicis. About the middle of the bone on this aspect the foramen is seen for the nutritious artery, which is directed from above to below.

The *external angle* proceeds from the outer side of the head of the fibula, downwards and backwards in a twisted direction, so as to separate the external from the posterior face of the bone, and assist in giving attachment to the muscles on each aspect, viz.—behind, to the soleus and flexor proprius pollicis; and externally, to the peronei muscles.

The *internal angle,* which is most acute in its centre, forms the point of junction between the internal and posterior faces of the bone, and assists in giving attachment to the muscles of each region, and also to the interosseous ligament.

The *anterior angle,* which proceeds downwards from the fore part of the head of the fibula, between the external and internal faces, forms the acutest angle of the three: the outer edge of this angle has the peronei muscles attached to it, and its inner edge the extensor communis digitorum and peroneus tertius. It should, moreover, be observed, that the body of the fibula sometimes presents more angles than have here been described; but they will be found only as irregularities upon the faces of the bone, depending on the size and strength of the muscles attached to it.

The *inferior extremity,* or *malleolus externus* of the fibula, is the largest part of the bone, and descends below the internal malleolus of the tibia. It is of an oblong form, flattened, and terminates by a projecting point. Its *external surface* is convex and rough, lying immediately underneath the skin, forming what is termed the outer ancle: the *inner* or tibio-tarsal surface presents an *articular face,* concave from behind forwards, which connects it with the astragalus; and immediately above this is seen a *rough depression,* which attaches this bone to the tibia; the anterior edge of the malleolus externus is thin and rough, while the posterior forms an obtuse edge, but equally roughened for the attachment of the ligaments which serve to strengthen the ancle and inferior tibio-fibular articulations. The projecting *apex* of the inferior extremity of the fibula, has connected with it the external lateral ligament of the ancle-joint, and is furnished with a *groove* at its posterior part, in which the tendons of the peronei muscles pass.

Use.—The fibula assists in the formation of the ancle, and of the superior and inferior tibio-fibular articulations. It also gives insertion to one of the muscles of the knee-joint, and origin to some of the muscles of the foot and toes.

Attachment of Muscles.—To the external face, the m. peroneus longus and brevis, and the m. biceps flexor cruris; to the inner face, the extensor longus digitorum, and extensor proprius pollicis; and on the posterior face, the m. soleus, tibialis posticus, and flexor longus pollicis pedis, are attached.

Practical Remarks.

The *patella* may be fractured transversely, or with different degrees of obliquity, but the longitudinal fracture rarely happens; for as the solution of continuity in this bone most frequently occurs by violent action of the extensor muscles, the transverse fracture is thus produced.

A fracture of this bone in a longitudinal direction is usually caused by a fall upon the bone itself, at a time when the knee being bent, the patella at its extremities is resting upon the femur and the tibia, whilst its middle part is without support, and consequently most liable to yield. Under these circumstances, the bone is sometimes comminuted. The injury may be discovered by examining the bone, when a fissure may generally be felt; displacement does not occur as when the fracture is transverse. The treatment consists in extending the leg, and placing a circular bandage around the knee,—at the same time enjoining rest, and using every precaution to guard against inflammation.

When a *transverse fracture* is produced, and which most frequently happens from the inordinate contraction of the extensor muscles in the act of saving oneself from falling backwards, the superior portion of the bone is drawn upwards by the muscles for an inch from the lower, *(Vide Fig.* 6, *Plate IX.)* and a considerable hollow may be felt between the two. The patient loses the power of raising the foot from the ground, and consequently of progressive motion, excepting in a retrograde direction, by which act the foot can be drawn along the surface of the ground, the knee being kept extended.

Treatment.—The limb should be extended to the utmost, bending the thigh upwards upon the pelvis, so that the limb is placed at an angle of 30° from the horizontal line of the trunk. By this position, the ligamentum patellæ, as well as the extensor muscles, are relaxed, and the upper portion of the fractured patella may readily be drawn down to the lower, which is connected with the tibia. A bandage should then be rolled on the thigh, so as to support, and at the same time diminish the irritability of the muscles; and this bandage should be passed from the thigh to the leg in the form of the figure of 8, behind the knee-joint, so as to cross one another in the ham for several turns, and thus embrace the sides of the patella; it may then be continued to the foot as a common roller, thus preventing partial compression. A circular strap should then be buckled on above, and another below the fractured patella, and these made to approximate by straps passing from the one to the other, by which means the fractured portions are maintained in a state of coaptation. A long hollowed splint should pass from the buttock to the heel, so as to prevent any motion of the limb. There is a difference of opinion, whether or not the patella is capable of ossific consolidation, or only of being united by ligamentous tissue. There seems to be no just reason for believing otherwise, than that the patella is as capable of reparation by bone as the rest of the osseous system; and, indeed, this is proved by the experiments of Sir Astley Cooper, who found that in longitudinal fractures, or even in transverse ones, where the broken portions were not separated from each other, that ossific consolidation occurred; so that it may be said, that the frequent failure in producing immediate reunion occurs from the difficulty in keeping the broken portions in apposition, and not from any peculiarity in the structure of the patella.

Fractures of Tibia and Fibula.—Although there is such analogy between the bones of the leg and of the fore-arm, as to structure, yet there is this difference with respect to their fractures, that it most frequently happens, with respect to the leg, that both bones are broken, while in the fore-arm, it more usually happens that one only is fractured: the cause of this difference it may be well to mention, as it depends upon the different mode of their articulations. In the arm, the radius is most frequently fractured alone, because in a fall upon the hand, with which it is articulated, it receives the whole weight of the body, and communicates the impulse to the humerus and not to the ulna; while by a fall on the feet from any considerable height, the tibia in a like manner receiving the whole weight of the body, gives way to the application of so great a force, which force continuing to operate, the fibula, now having lost the support of the tibia, is subsequently broken. They may, however, as happens to the bones of the fore-arm, be both broken at the same time, and parallel to each other, by a force applied directly on the part of the bones fractured, as when a heavy weight passes over

p 153.

Plate 11

Fig. 1.

Fig. 2.

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the limb. When both bones are broken, a diagnosis is easily formed from the pain, loss of motion, altered form of the limb, and by crepitus being perceptible upon rotating the foot. The position of the fractured bones is generally angular, the upper portion being directed forwards and inwards, while the lower portion is drawn backwards and outwards, by the muscles of the calf of the leg. *(Vide Fig.* 1., *Plate X.)* But longitudinal derangement very rarely occurs, in consequence of the extent of surface the fractured bones present, unless the fracture be very oblique, and then some slight shortening may occur. The treatment of fracture of both bones consists in making extension from the foot, and counter-extension from the knee; and usually by a very slight force coaptation is produced, which may be readily known by tracing the anterior angle of the tibia, which is so little covered by soft parts as to render the slightest deviation from the natural direction perceptible. While the limb is held in this position, a long well-stuffed pad should be adjusted on each side the leg, so as to fill up all the natural depressions of the limb; over these the lateral splints are applied, which should be of sufficient length to pass beyond the foot, so that all its movements may be prevented; for it is by the motions of the foot that derangement of the fractured portions is most likely to recur. The splints are sometimes furnished with what is called the foot-piece, for the purpose of retaining the limb in its proper position, but the long splints do equally well. A third splint may be applied on the anterior part of the leg, which answers not only the purpose of keeping the bones in their proper position, but also forms a good defence to the leg, from the tapes which are applied for the purpose of permanently securing the splints. The limb may be placed either upon the side or upon the heel, in whichever position the surgeon finds best suited to the circumstances attending the accident; if upon the heel, great care should be taken that every part of the posterior surface of the leg is equally supported, which may be effected by means of bags of bran, or dossils of lint, and that the heel is neither elevated or depressed; for in the first case, the lower portion of the fractured bone would be thrown backwards; and in the second, it would form a salient angle forwards. The surgeon, upon subsequent examination, may always satisfy himself that the limb maintains its proper position, by attending to the direction of the great toe, which ought always to lie in a direct line with the centre of the patella.

Fracture of the Tibia.—When this bone is fractured alone, the accident is more difficult to discover than when both bones are broken, in consequence of the very slight degree of derangement of the fractured portions. But when there is reason to suspect this occurrence from a fall or a blow, the anterior angle is to be carefully traced, upon which the slightest inequality may be detected, and consequently the extent of the injury ascertained. The fibula remaining whole, will not admit of sufficient separation of the fractured portions for crepitus to be produced; but the friction of these portions may be sufficiently diminished by extension and counter-extension, as to admit any slight derangement being corrected. The same treatment is to be followed as when both bones are broken.

Fracture of the Fibula.—If the fibula alone be fractured, and much tumefaction ensues, it is often difficult to detect it; more particularly as the patient is frequently able to walk after this injury. In whatever direction the bone may be broken, the pieces are not susceptible of a longitudinal derangement, but are always drawn inwards towards the tibia; *(Vide Fig.* 2, *Plate X.)* so that the best means of detecting this fracture is to press the fibula towards the tibia, when crepitus will be perceived. Fracture of the fibula is frequently produced by the foot being forcibly driven outwards during its progressive motion, so that the astragalus, striking violently against the malleolus externus, that portion of the bone gives way just where it is attached to the lower extremity of the shaft. In the treatment of fractures of the fibula, the outer splint should project beyond the foot, so as to prevent its rotation outwards.

The Foot.

The foot forms the third part of the lower extremity, is situated inferiorly with respect to the leg, which is attached to its upper surface at a right angle, nearer to its posterior than to its anterior extremity: it is composed of the bones of the *tarsus,* placed posteriorly; of the *metatarsus,* in the middle; and of the *phalanges,* in front.

The Tarsus

Forms the posterior middle part of the foot, and is composed of seven bones;—the *astragalus, calcis, scaphoid, cuboid,* and three *cuneiform* bones, which are so articulated as to form an arch sufficiently strong to bear the whole weight of the body, and yet sufficiently elastic to prevent severe concussion.

The *astragalus* is the uppermost of the bones of the tarsus, and forms a superior projecting prominence, which is admitted between the malleoli of the tibia and fibula, to compose the ancle-joint. Immediately beneath this bone is placed the calcis, which reaches no further forwards than the astragalus, but projects considerably backwards to form the heel; these two bones are so connected with each other, that the astragalus is directed anteriorly to the inner side, while the calcis faces forwards to the outer edge of the foot; to the former is articulated the scaphoid, or navicular bone; and to the latter, the os cuboides. The navicular bone is so short as not to reach to the metatarsal bones; while, on the contrary, the cuboid bone does extend from the calcis to the metatarsal bones of the little toe and toe next to it; so that the space between the navicular and the three inner metatarsal bones is filled up by the three cuneiform bones. These tarsal bones, when thus connected, form an arch, the convexity of which is facing upwards on the dorsum of the foot, from before to behind, as well as from side to side; while, in the sole of the foot, a concavity is maintained in the same direction.

The Astragalus.

This bone is divided into its *body, neck,* and *head.*

The body, *above,* presents a large articular surface, which is convex from before to behind, and slightly concave from side to side, for its attachment to the tibia, being broader anteriorly towards the neck of the bone than it is posteriorly, so as to admit of lateral motion of the foot during its extension.

The *inner* surface of the body of the astragalus is divided, above, into an articular, and below, into a rough non-articular surface: the former, which is articulated with the internal malleolus, is large and rounded in front, and forms an acute termination posteriorly. The non-articular surface below, gives attachment to strong tarsal ligaments.

The *external surface* of the body forms a larger articular face than the inner, to be connected with the outer malleolus:

it is of a triangular form, with the base situated above, and the apex below; being slightly concave from above to below. The *posterior surface* is the smallest and thinnest portion of the bone; it presents to the outer side of its centre a small *tubercle*, which gives attachment to the posterior calco astragalan ligament; and immediately to the inner side of this tubercle is situated a *sulcus*, which admits the passage of the tendon of the m. flexor longus pollicis. The *inferior surface* is hollowed out into a large articular depression, which is concave from behind to before, to connect it with the calcis: the circumference of this depression is rough for the attachment of ligaments.

The *neck* of the bone is directed from the body, with an obliquity forwards and inwards, to terminate in the head of the bone. The superior surface of the neck is rough, for the attachment of ligaments, which strengthen the articulation between the astragalus and navicular bone. Its *external* surface is longer than its *internal;* and inferiorly, this portion of the bone is formed of a deep sulcus, directed from behind to before, and from within to without, which, in the recent subject, is filled up by strong ligaments, to connect the astragalus and calcis.

The *head* of the astragalus is composed of an *anterior* and an *inferior articular process:* the *anterior one,* which is connected with the os naviculare, forms a considerable convexity from side to side, and is bounded by an irregular circumference for the attachment of ligaments: the *inferior one,* which has its long axis directed from behind to before, with some slight obliquity outwards, is common to the inferior surface of the neck, as well as to the head of the bone, and is destined to be partly resting on the astragalus, and partly on a strong plantar ligament.

Use.—This bone assists in forming the ancle-joint, receives the whole weight of the body from the tibia, and, by its articulation with the calcis and tarsal ligaments, it conveys the weight to the foot without producing concussion.

Attachment of Muscles.—The only muscle attached to this bone is the tibialis posticus.

The Os Calcis.

This is the longest bone of the foot, and constitutes the base of support for all the other bones of the tarsus: it is of a very irregular form, and presents a *superior*, an *inferior*, an *external*, an *internal*, an *anterior*, and a *posterior surface.*

The *superior* surface presents, rather anterior to its centre, two articular surfaces, which are separated from each other by a deep sulcus, the direction and form of which correspond with the under surface of the astragalus. Behind these articular surfaces is situated the upper part of the great projecting protuberance, forming the heel, which on this aspect presents a surface concave from before to behind, and convex from side to side. Anteriorly to the outer side of the smaller articular surface, but immediately in front of the larger one, the bone is roughened for the attachment of the superior calco cuboidal ligament, and origin of the m. extensor digitorum communis.

The *inferior surface* of the calcis is smaller than the superior, and presents an irregular concavity from behind to before, assisting to form the longitudinal arch of the foot. On its posterior part are placed two tuberosities; the larger one on the inner side, and the smaller on the outer: they give attachment to the m. adductor pollicis, flexor brevis digitorum communis, and the abductor minimi digiti.

The *anterior surface* is formed entirely of an articular face, which is somewhat triangular, and concave from above to below, to be connected with the cuboid bone.

The *posterior surface* is convex from above to below, as well as from side to side; presents, above, a smooth flattened triangular surface, pointing out the position of a bursa, between the bone and the tendo-achillis; below, it is rough for the firm attachment of the tendons.

The *external surface,* which is flat and much larger posteriorly than it is anteriorly, is marked in its middle, immediately below its posterior and superior articular surface, by a groove for the passage of the tendons of the peronei muscles.

The *internal* surface is large, and concave from above to below, to lodge the tendons of the m. tibialis posticus, flexor longus digitorum communis, and the flexor longus pollicis pedis; and also the vessels and nerves passing to the sole of the foot. A slight protuberance may be seen upon the middle of the posterior part of this surface, for the origin of the m. accessorius; and on the anterior and upper part, a sulcus, to lodge exclusively the tendon of the flexor longus pollicis.

Attachment of Muscles.—The m. extensor brevis digitorum, to the anterior part of the *upper* surface; to the *under* surface, the m. abductor, flexor brevis, and adductor pollicis, flexor brevis digitorum, and abductor minimi digiti; and to its *inner* surface, the flexor digitorum accessorius.

The Navicular, or Scaphoid Bone.

This bone is somewhat circular in form, is placed on the inner side of the middle of the foot, and presents an *anterior* and *posterior* articular surface, a *dorsal* and *plantar* non-articular aspect, and an *internal* and *external* extremity.

The *anterior* articular surface is covered with cartilage, is slightly convex from side to side, and presents three distinct faces for the articulation of the three cuneiform bones; the two outer of these faces are larger above than they are below, while the inner is larger below.

The *posterior* articular surface forms an oblong concavity, to receive the astragalus.

The *superior*, or *dorsal* aspect, is convex from side to side, and rough for the attachment of ligaments.

The *inferior*, or *plantar* surface, is also rough, but irregularly concave from side to side, to maintain the transverse arch of the foot.

The *inner extremity* forms a projecting tubercle, to which is attached the abductor pollicis, in part, and the tendon of the m. tibialis posticus; and also the strong plantar ligaments.

The *outer extremity*, at its upper and posterior part, presents a small *articular* surface, where it is connected with the cuboid bone.

This bone does not reach the metatarsal bones, but a space is left between them and the navicular, for the three cuneiform bones.

Attachment of Muscles.—The m. tibialis posticus is partly inserted into the under surface of the bone.

The Three Cuneiform Bones

Are placed so as to be articulated, behind, with the navicular; in front, with the metatarsal bones, supporting the three inner toes; and externally, with the cuboid bone.

The Internal Cuneiform Bone

Is the largest of the three, is of an irregular prismatic form; its *base* situated below, and its apex above; it presents a *posterior articular* surface, concave from side to side, which is connected with the navicular bone, and an *anterior*, plain, articular surface, lengthened from above to below, to join it with the metatarsal bone of the great toe. Its *external* surface is concave, and presents *two articular* faces, a *posterior* one which is placed vertically, to be connected with the middle cuneiform bone; and to the *anterior* and *superior* horizontal face, the metatarsal bone of the second toe is articulated. The *internal surface* is scabrous, and is furnished with two tubercles, which give partly origin to the m. abductor pollicis, and insertion to the tibialis anticus. The *apex* is situated on the dorsum of the foot, and is directed obliquely from behind to before, is rough, and gives attachment to ligaments. The *base*, which is placed in the sole of the foot, also is rough for the firm connexion of the plantar ligaments.

Attachment of Muscles.—The m. tibialis anticus and posticus, and peroneus longus, are inserted into it.

The Middle Cuneiform Bone

Is the smallest of the three; it is situated at the anterior part of the middle of the tarsus, and is divided into *four articular surfaces*, a *base*, and an *apex*. Its *posterior* articular surface is concave, and broader above than below, to be articulated with the middle part of the os naviculare. Its *anterior* surface is convex, and is articulated with the posterior extremity of the metatarsal bone of the second toe. The *internal* face has a smooth flat surface above and behind, by which it is in contact with the internal cuneiform bone; and a small rough fossa below, for the attachment of ligament. The *external* surface is slightly hollowed, where it is contiguous to the external cuneiform bone.

The *base* is nearly quadralateral, but rather longer than broad, slightly convex from side to side, is situated on the dorsum of the foot, is rough and penetrated by numerous foramina.

The *apex* is very thin, passes into the sole of the foot, and assists, from its wedge-like form, in producing the transverse arch.

Attachment of Muscles.—The m. tibialis posticus is partly attached to this bone.

The External Cuneiform Bone.

In shape it somewhat resembles the preceding, but is longer from before to behind; it is larger than the middle, but not so large as the internal cuneiform bone; it has its *base* placed above, and its *apex* below, and presents five *articular surfaces.*

Its *base,* or superior surface, is rough, longer than it is broad, and forms a part of the dorsum of the foot.

Its *apex*, which is thin, passes into the sole of the foot.

The *anterior* articular surface is flat and smooth, to be connected with the metatarsal bone of the third toe.

The *posterior* face is inclined somewhat inwards, to be articulated with the navicular bone.

The *internal* surface presents two articular faces; the posterior one the larger, which is connected with the middle cuneiform bone, while the anterior one receives a portion of the metatarsal bone of the second toe; and between these two articular surfaces, the bone is rough for the attachment of interosseous ligaments.

The *external* surface presents a large rounded articular face, by which it is joined to the cuboid bone.

Attachment of Muscles.—The m. flexor brevis and adductor pollicis pedis, and part of the tibialis posticus, which is attached to all the cuneiform bones, are connected to the os cuneiforme externum.

Os Cuboides.

This bone is situated at the anterior and outer part of the tarsus, being placed between the calcis and metatarsal bones of the fourth and fifth toes.

The *superior* surface of this bone is broad, rough, and directed obliquely outwards, forming a considerable portion of the outer edge of the tarsus. Its *inferior* surface is divided into two by a deep *sulcus*, which is directed from without to within and from behind to before, and lodges the tendon of the peroneus longus. The portion of bone anterior to this groove is rough, for the attachment of ligaments connecting the cuboid with the metatarsal bones; and posterior to the groove, a considerable protuberance is formed for the insertion of the inferior plantar ligament.

The *anterior* face presents an articular surface, which is directed from within to without, and from before to behind, divided into two parts for the articulation of the fourth and fifth toes.

The *posterior* face is convex from above to below, and slightly concave from side to side, to be articulated with the calcis. The *internal* face has two articulatory surfaces: the larger flattened anterior one, to connect it with the external cuneiform, and the posterior, for its junction with the os naviculare. The *external* face forms a thin edge, which, in its centre, is furnished with a notch, marking the situation of the groove for lodging the tendon of the peroneus longus muscle.

Attachment of Muscles.—The m. adductor pollicis pedis, and flexor brevis minimi digiti, are attached to the cuboid bone; and sometimes the flexor brevis pollicis pedis.

The Metatarsal Bones

Form the second division of the bones of the foot. They are five in number, and are placed between the tarsus and the toes: their form is cylindrical, and are thicker at their two extremities than in the centre.

The first, or metatarsal bone of the great toe, is the thickest, but the shortest of the five: it is divided into a *posterior* or *tarsal,* and an *anterior* or *digital* extremity; and a *middle* part, or *body.*

The *tarsal extremity* presents a concave articular surface, which is divided into a large superior and a smaller inferior portion, to be connected with the internal cuneiform bone; the circumference of this extremity is semilunar in form, being flattened *externally,* where it is connected with the metatarsal bone of the second toe; convex and rough *internally,* for the attachment of ligaments: the *inferior* surface presents a tubercle, into which the tendon of the peroneus longus is inserted.

The *body* of the bone is triangular and contracted. Its superior surface is convex, both from behind to before and from side to side. Its *inferior* surface is concave from behind to before, to preserve the longitudinal arch of the foot. The *external* surface is hollowed out, particularly in its centre, so as to leave a considerable space between it and the metatarsal bone of the second toe. The *internal* surface is flattened.

The *anterior,* or *digital* extremity, is also called the *head* of the bone, and forms a large, rounded, smooth, articular surface, which is articulated with the first phalanx of the great toe. On the inferior surface of the head are placed two small *articular depressions,* separated from each other by a slight projection of bone, which lodge the two sesamoid bones proper to the first tarso-phalangeal articulation. The circumference of the head is rough, for the attachment of the capsular ligament, and the sides are furnished with two small tubercles, to which are attached the lateral ligaments of the joint.

The *metatarsal bone of the second toe* is the longest of the whole, and passes backwards into the tarsal region, between the internal and external cuneiform bones, to be connected with the middle cuneiform bone.

Its *tarsal* extremity presents a posterior concave articular surface, to be joined with the middle cuneiform bone. Laterally and externally, two articular surfaces are placed; a posterior one, by which it is joined to the external cuneiform bone; and an anterior one, which connects it with the metatarsal bone of the third toe. Internally, the head presents one flat surface, for its junction with the internal cuneiform bone.

The *body* of this bone offers nothing remarkable.

The *anterior extremity,* or *head,* presents an articular surface, more extensive above than either below or laterally, and is articulated with the first phalanx of the second toe; the circumference of the head is rough, and furnished superiorly with a deep sulcus for the attachment of the capsular ligament.

The *metatarsal bone of the third toe* is the next in length of the bones of the metatarsus. Its *tarsal extremity* presents a flattened surface, which is directed with some slight obliquity from within to without, to be connected with the external cuneiform bone. It is joined internally with the metatarsal bone of the second toe, and externally with the metatarsal bone of the fourth toe.

The *body* and *head* of this bone resemble so much the description of the last, as to require no further explanation.

The *metatarsal bone of the fourth toe* is nearly as long as the former. The *tarsal* extremity of the bone, posteriorly, is furnished with an oval articulatory surface, somewhat elevated in the centre, and is connected with the cuboid bone. Its internal face is joined to the metatarsal bone of the third toe, and externally it is in contact with the metatarsal bone of the fifth toe. The *body* and *head* of this bone are similar to the second and third.

The *metatarsal bone of the fifth toe,* at its posterior or tarsal extremity, presents a regular convex articular surface, inclined inwards, which is articulated with the cuboid bone; while the outer extremity forms a protuberance which projects behind and externally to its articulation with that bone. Anterior to the face for its articulation with the cuboid bone, is situated a small articulatory surface, for its connexion with the metatarsal bone of the fourth toe. The *body* of this bone presents a superior surface, which is convex from within to without; its *head* offers nothing remarkable.

The five metatarsal bones are so connected with each other, and the bones of the tarsus, as to form a convexity from side to side on the dorsal aspect, and a concavity from side to side in the plantar region.

Attachment of Muscles.—Muscles common to the metatarsus are the m. interrossei and transversalis pedis: proper to the first metatarsal bone m. tibialis anticus and peroneus longus: to the second m. adductor pollicis pedis: and to the fifth, m. peroneus brevis, abductor and flexor brevis, minimi digiti.

The Toes

Form the third division of the bones of the foot, and are five in number. They are composed of fourteen bones termed *phalanges;* each of them being furnished with three of these bones, excepting the great toe, which has but two, as the great toe wants its middle phalanx. The phalanges are classed as the *posterior, middle* and *anterior row.*

The *posterior* or *first phalanges* of the toes are longer than the others, and present a body and two extremities. The *posterior* extremity is furnished with a semilunar concave articulatory surface, which receives the head of the metatarsal bones; and on their planter surface a *sulcus* is seen, which is directed from behind to before, covered with cartilage, and lodges the flexor tendons of the toes. The lateral parts of this extremity are each formed with a tubercle, to give attachment to the lateral ligaments. Their *anterior* extremity presents two articular apophyses or condyles, which are separated from each other more inferiorly than superiorly by a sulcus. They are connected with the posterior extremity of the second phalanges. The *bodies* of the first phalanges form a convexity from behind to before on their dorsal surface, a concavity from behind to before on their plantar surface, and are contracted in the middle.

The *middle* or *second phalanges,* of which there are but four, the great toe not having one, are very short, being nearly square. Their *dorsal* surface is concave from behind to before, and convex transversely. Their *plantar* surface is also concave from behind to before. Their *posterior* extremity presents an articular depression, divided into two parts by a middle projection, which is directed from above to below, and is articulated with the anterior extremity of the first phalanx. The *anterior* extremity presents an articular surface, exactly corresponding to the description of that of the first phalanx.

The *extreme* or *third phalanges* are very small, excepting that of the great toe, which is of considerable size. Their figure is pyramidal; their superior and inferior surfaces are concave from behind to before, and are roughened for the attachment of tendons. Their *posterior extremity* is furnished with an articular cavity, similar to the posterior articulatory surfaces of the second phalanges. Their *anterior extremity* is rounded and scabrous, more especially on the dorsal surface, for the attachment of the condensed tissue which secretes the nail.

Attachment of Muscles.—Muscles common to the phalanges are the m. extensor longus et brevis, digitorum pedis, interossei, inserted into their dorsal surfaces: into their plantar surfaces are inserted the m. flexor longus digitorum pedis, into the third phalanges, the m. flexor brevis into the second, and the m. lumbricales into the first. The muscles proper to the great toe are the m. flexor longus et brevis, abductor pollicis and extensor longus pollicis pedis.

Ossa Sessamoidea

Have derived their name from their form: they are small bones, placed in certain articulations of the toes and fingers. Their number, size and situation vary in different individuals, but seem to bear a proportion to the developement of the muscular system. The sesamoid bones, at the articulation of the first phalanx of the great toe with the metatarsal bone, are seldom wanting; they are not only for the purpose of giving attachment to muscles, but also to encrease their power of action. The sesamoid bones have been supposed to be formed in consequence of pressure; but this stimulus does not seem to be necessary to their developement, as they are frequently found in the fœtus a few months after conception.

Practical Remarks.

The bones of the foot are but little liable to fracture in consequence of their conformation, their mode of articulation with each other, and their structure: indeed, all those circumstances which have already been stated as tending to prevent fracture of the bones of the hand, apply equally to the bones of the foot, if we except the os calcis; while this bone, from the manner in which it projects backwards, to receive the insertion of the extensor muscles, is liable to solution of continuity, either from the sudden contraction of the gastrocnemii muscle, or the application of external violence. It is much more frequent, however, for the tendo Achillis to be ruptured, than for the bone to give way when influenced by the inordinate action of the muscles.

Fracture of the Os Calcis.

Although the os calcis is, of all the bones of the tarsus, the most likely to be fractured, still, the dimensions of the bone in every direction are so nearly equal, that it is a rare occurrence to meet with the accident; but Boyer recites examples of these cases, both from the action of muscles, and from falling on the foot from a considerable height. The nature of the accident may be known by swelling and pain following a fall on the sole of the foot, the pain being much increased by motion; the inability to walk or move the foot, and by a crepitus being perceptible if the projection of the calcis be moved upon the body of the bone. Separation of the fractured portions is not very readily ascertained, in consequence of the thickness of the integuments of the foot.

The treatment of this accident consists in extending the foot and flexing the knee, by which position of the limb, the tendo Achillis is completely relaxed: indeed, the treatment is much the same as in rupture of the tendo Achillis, excepting that some pressure is required from behind to before, to keep the fractured portions in more complete apposition.

The other bones of the tarsus are only liable to comminutive fracture, and the same may be said of the bones of the metatarsus and phalanges.

Observations upon the general Treatment of Fractures.

In the treatment of all fractures of the long bones, two great points are to be attended to:—First, to bring the fractured portions in contact; and, secondly, to retain them there. It is frequently a matter of very great difficuly to answer the first intention, in consequence of the action of muscles; it is therefore essential to relax as much as possible the muscles attached to the fractured bone, which is effected by semiflexing the joints of which the injured bone forms a part. It should be remembered, however, there are some deviations from this general rule: as in fractures of the olecranon and patella, in which cases it requires permanent extension of the limbs, to produce relaxation of the muscles influencing the fractured bones.

There are also other circumstances which are to be considered by the surgeon before any general rule of treatment can be laid down: such as the class of bone subjected to the accident, bearing in mind that the *flat bones* when fractured are but little influenced by muscles, and that the danger which ensues is depending upon the degree of injury done to the important organs contained in the cavities formed by this class of bones: as in the head and pelvis: and that the object of the surgeon is to avoid any subsequent ill effects, by strict attention to the antiphlogistic regimen and perfect rest.

The *short bones* are, as has been before remarked, but little liable to fracture, in consequence of their form and spongy texture; and that, when broken, the soft parts have usually suffered so much from contusion, that the surgeon's attention is more directed first to subdue the inflammation than to replace the bone. Fracture of these bones is, moreover, dangerous from their vicinity to joints, and also from the greater quantity of animal matter that enters into their composition, rendering them more liable to subsequent inflammation and disease.

Compound fracture differs only from simple in there being an external wound communicating with the fractured extremity of the bone, by which, indeed, the wound is generally produced. The treatment only differs in removing every extraneous substance and portions of bone if it be comminuted fracture, then closing the wound, and assisting nature in every way to convert it into a simple one. The means to be adopted to relax the muscles, and to keep the bones in their natural position, is precisely the same in compound as in simple fracture.

Immediately after fracture of any bone in which there is a tendency to great tumefaction, it is wrong to apply either splints or bandage, for any restriction of swelling is liable to produce gangrene: under these circumstances the limb should be placed on a pillow in a semi-flexed position, so that the muscles may be perfectly relaxed, and the bones placed as near as possible in their natural position; which circumstances may be ascertained, whatever may be the swelling, by the immediate comparative ease of the patient. An evaporating lotion is then to be used; or should there be any tendency to involuntary contraction of the muscles, strips of soap-plaister may be gently applied around the limb, which, by causing a secretion beneath it, diminishes the irritability of the muscles, as well as the urgency or the inflammation. If it can be avoided, purgative medicines should not be given, as they would produce a necessity for frequent change of position; but should their use be considered essential, such medicines should be given as are least likely so keep up a continued action on the bowels. As soon as the tumefaction and inflammation have subsided, which, under the treatment recommended, generally happens in three or four days, well padded splints should be applied, and retained in their situation by broad pieces of tape resting firmly on the splints, but should not any where be in contact with the limb.

It has been stated, that a bandage should never be applied immediately after the occurrence of fracture: however, it may be considered as an exception to this rule, that, when a portion of fractured bone has wounded and irritated a muscle, a bandage is the best means of relieving its spasmodic action. When fracture of a bone happens in the neighbourhood of, or passes into a joint, local bleeding, by means of leeches, is always necessary, and may require frequently to be repeated: even the necessity for general bleeding may sometimes be indicated when there is much constitutional irritation, in which case calomel and opium will also be found of the greatest service. In fractures into joints, when inflammation becomes so violent that the surgeon sees that anchylosis must necessarily occur, the joint should be placed in such a position as to render the limb as useful as possible. Under these circumstances, for instance, if the elbow-joint be the one affected, the fore-arm should be semiflexed; by which position the patient will be afterwards able to feed himself. In the knee-joint the leg should be very slightly flexed upon the thigh, by which method he is better able to direct the foot, and the limb is rendered more manageable in the sitting posture. In the ancle-joint we should endeavour to procure a union with the foot perfectly flat, whereby the patient will afterwards enjoy very considerable use of the limb.

Fractures of the Flat Bones.

Injuries of the Head.—In simple fractures of the cranium, little is required of the surgeon, as the danger and importance of the accident arises from the probability of injury to the important and vital parts they inclose: hence the necessity of strict attention to the antiphlogistic regimen and rest. The consequence of a severe blow on the head is either *concussion* or *compression*.

In *concussion* the brain is merely shaken, and is neither lacerated or compressed upon, and may be ascertained by the following symptoms:—The patient appears stunned, his pulse weak and fluttering, the face pale, and the extremities cold—such occurs immmediately after the accident; but in a short time reaction commences, and a new form of symptoms presents itself. The patient now remains in a half comatose state, with his senses weakened but not lost; his power of volition suspended but not destroyed. If he be addressed loudly by his name, he is capable of giving a rational answer; and when thus roused, his pulse is found to rise from its natural number to a hundred and twenty: the pupils of the eyes, in simple concussion, have a natural appearance, and are capable of being stimulated by light: nausea, and even vomiting, are frequently concomitant symptoms. It is undecided whether concussion be produced by venous congestion on the brain; but this can hardly be considered to be the case, as it is known that vomiting frequently restores the sense of the patient, which must necessarily have a tendency to increase the flow of blood to the head.

Of Compression.—Compression, which not unfrequently follows concussion, is known by the patient being quite comatose, and volition being totally lost. The pulse is small, hard, and generally irregular, sometimes even intermitting: the pupils are dilated, the retina being no longer sensible to light; it however sometimes happens that one pupil will be contracted whilst the other is dilated. The breathing is stertorous. When the injury is very severe, hemiplegia is produced, and most frequently on the opposite side to which the injury had been received. These various symptoms may arise either from bone pressing upon the brain, from extravasation of blood, or from the formation of matter. If from the first cause, the symptoms will come on immediately after the accident; and upon examination, if the finger be steadily pressed upon the part, irregularity of the bone may be detected ; and the more firmly you press, the more distinctly will you feel the edge of the fractured bone. This circumstance is mentioned, as swelling of the scalp communicates a feeling as if the bone were depressed ; but in this case, if the pressure be made firmly, the sensation of depression immediately ceases. If extravasation be the cause, the symptoms, as enumerated, come on gradually after the accident; sometimes hours and even days elapse before they are fully developed, depending upon the size of the vessel which is ruptured. And lastly, when matter forms, days and even weeks may supervene before the accession of the symptoms, and they are always preceded by inflammatory action, by sickness and rigors. With these symptoms, which too frequently but insidiously progress, unattended with pain, the surgeon is led most attentively to examine the scalp over the seat of the injury, where a puffy appearance will sometimes point out the situation of the mischief. If there happen to have been a wound, the formation of matter may be more clearly defined; as now, however healthy its appearance might have been before, it puts on an unhealthy aspect; the granulations become glossy, and the discharge thin and ichorus.

Treatment of Concussion and Compression.

In both concussion and compression, as soon as reaction has taken place, large quantities of blood should be taken from the jugular vein or temporal artery ; the quantity, however, must depend upon the powers of the patient. A dose of calomel should be immediately given ; which if the patient cannot swallow, should be passed into the fauces, mixed up with butter; and in an hour after, small doses of the sulphate of magnesia should be administered : a sinapism should be applied to the soles of the feet; the head should be shaved ; and if the symptoms be not relieved by cold applications, a blister should be applied to the scalp. If all these means fail, under what circumstances are we to trephine ? If there be a wound communicating with the bones of the skull, accompanied with fracture and depression: in such cases, although no untoward symptoms have yet arisen, we are recommended immediately to trephine ; but of the propriety of this step there seems to me some doubt. We should rather be led to judge of the necessity for the immediate application of the trephine by the *degree* of depression, and by the *part* of the skull injured ; for as the quantity of diploe differs so much in different skulls, there is no evidence of the brain being injured until symptoms supervene; and I would therefore recommend that the patient should be most narrowly watched, and that the trephine should not be applied until symptoms point out the necessity. When compression occurs from the formation of matter, which, as already mentioned, does not come on until some time after the accident, the surgeon is placed under the greatest difficulty to discover the precise seat of the injury, as it is not always at the part where the blow was inflicted. To ascertain this essential point the scalp must be most carefully examined, and a puffy appearance may be found opposite to the part where the matter is situated. An incision is to be made through this part and the skull exposed, which will be found denuded, or at any rate its perecranium easily separable from it: the bone itself will be of an ash colour, without any tendency to bleed. These circumstances will prove that you are justified in removing this portion of bone. I have seen my colleague and relative, Mr. Key, under these circumstance, perform this operation with perfect success as far as refers to the evacuation of the matter, although the patient did not subsequently recover, in consequence of the extent of injury the brain had sustained.

The fractures of the bones of the pelvis, need no further account than has already been given with the description of the individual bones.

LECTURES ON ANATOMY.

PART II.

PARTS ESSENTIAL TO THE SKELETON.

LECTURE V.

PARTS ENTERING INTO THE COMPOSITION OF JOINTS.

In treating of articulations it will be necessary, in the first place, to give a separate consideration to each of the parts and structures which enter into their composition; for, although in cutting into a healthy joint, bone is not exposed, yet the first great character of a moveable articulation is the approximation of two or more bones, so far fitted to each other, which are rendered capable of performing its various functions by the addition of *cartilage, synovial membrane,* and *ligaments;* and these structures, although subservient, tend to strengthen the articulation, and to give freedom and ease to its motions.

Cartilage.

Cartilage represents a solid, polished and very elastic substance, of a pearly whiteness: it is slightly flexible, less hard and lighter than bone, but, excepting it, offers more firmness than any other structure in the body. In texture its fibres are very indistinct, being scarcely perceptible. This homogenious appearance is in consequence of the great quantity of animal matter which enters into its composition, and from the small quantity of cellular membrane which connects its fibres; but by maceration or boiling, its fibrous and laminated texture may be demonstrated.

In a state of health, no *blood-vessels* can be traced into cartilage, because they circulate only the colourless parts of the blood; but under inflammation, or if there be a tendency for the cartilage to be converted into bone, immediately these vessels circulate the red particles of the blood, and they become visible. The ramifications of *nerves* and *absorbents* are also too small to be perceptible, but the existence of both cannot be doubted as essential to the growth and developement of the system; indeed, the diseases to which it is liable, prove they enter into its composition.

The chemical analysis of cartilage resembles bone in being composed of animal matter and phosphate of lime; but it is in the proportions of these two substances that they differ. According to Sir Humphrey Davy, cartilage consists of 44· 5 albumen; 55· water; and ·5 of phosphate of lime.

Cartilage is usually found disposed in a layer; very thin in proportion to its length and breadth, and is covered by a fibrous membrane called perichondrium, excepting some of the articular cartilages, which on the one surface is connected with bone, and on the other with synovial membrane. Cartilages are divided into two distinct classes, the *temporary* and *permanent*.

The *temporary* cartilages are found most abundant at the earliest periods of life, and diminish by their conversion into bone as the osseous system becomes developed; which, when completed, the temporary cartilages disappear. This class of the cartilaginous system is to be considered as essential to the production of bone; whether for its original formation, for its reparation after injury, or for its accidental growth.

The *permanent* cartilages, on the contrary, in health do not vary in number during the different epochs of life; not being, like the temporary, convertible into bone; but they maintain all their physical properties, for the purpose of assisting in the performance of the functions of those organs of which they form a part, subjected only to the changes common to all structures in the advancement to old age.

Permanent cartilage is found in three situations in the animal economy:—First, when it forms distinct organs, as the trachæa and larynx; secondly, where it enters into the composition of articulations; and, thirdly, where it lines depressions in the bones, for the purpose of facilitating the motions of tendons. Of the first and third kind I shall not now treat, but leave them for more minute description when speaking of the particular parts to which they belong.

Articular Cartilages.

From what has already been said of the physical properties of cartilage, more especially from its elasticity, we should expect to find it in those situations most subjected to pressure, concussion, and contortion; hence it occurs between all the connecting surfaces of bones, to a greater or less extent, as they are subjected to these contingencies; and, moreover, we find that these cartilages differ both in structure and form, according to the kind of motion to which they are subservient. It becomes therefore necessary to subdivide articular cartilages into *four classes*:—*First,* when it covers the articulatory processes of those bones admitting of the greatest extent of motion, and subjected to the most pressure; having one surface so firmly connected to the bone, that it seems as a continuous structure, destitute of phosphate of lime; whilst its other free or articular surface is covered by synovial membrane, which separates it from the cartilage of the corresponding bone entering into that joint. The texture of these cartilages consist of fibres, passing in the same direction as those of the bones from which they emanate, and becoming softer towards their free or synovial extremities.

The *second class* of articular cartilages is comprehended in those which connect the edges of flat bones, and which admit of no greater extent of motion between them than their yielding nature will allow. These cartilages have two of their surfaces continuous with the bones which they connect, while the rest of their surfaces are covered with perichondrium. In this class the sutural cartilages of the bones of the skull are comprised, as well as those connecting the bones of the pelvis. All of them are of a wedge-like form, having their external surface larger than the internal.

The *third class* of articular cartilages may be considered as intermediate between the other two, and constitutes the medium of connexion between the ribs and the sternum. Here we find the cartilage emanating from the extremity of the rib, passing forward in the same form as the rib itself, and continued in the same direction towards the sternum, to which bone it is joined by the intervention of synovial membrane. From the great length to which it is prolonged, what would constitute its surfaces in the two first classes, are here converted into its extremities. Thus it will be found to resemble the first kind, by having one of its surfaces or rather extremities continuous with bone, while the other is covered with synovial membrane; and it is also analogous to the second kind, in being covered with perichondrium, and allowing of motion, from its elastic and yielding structure.

The *fourth class* are termed the interarticular cartilages, which differ from the rest in not being in contact with the osseous system, but having both their surfaces covered by synovial membrane, and thus dividing the joint to which they belong into two synovial cavities. These cartilages are more fibrous than any of the other class, and are for the purpose of adapting their articulatory surfaces to the varied motions of the bones between which they are placed, to the extremities of which they always present a corresponding surface.

Practical Remarks.

The slowness with which the vital principle of cartilage manifests itself, the little tendency it has to be acted upon by morbid causes, and the slight power which it possesses of reparation, all render it liable to but few of the diseases which are incident to more highly organized structures. We therefore find that wounds in cartilage do not unite, like most of the other structures of the body, by the reunion of their surfaces, but that an intermediate ligamentous structure forms the bond of union between the divided edges. This incapability of generating cartilage is further obvious in cases of unreduced dislocations, in which we find that nature has been able to reproduce all the structures necessary to the formation of a new joint, excepting articular cartilage; for, although cartilage may be formed during this process of reparation, it is only of the temporary class, which is yet destined to be converted into bone. When the articular cartilage of a joint is destroyed, anchylosis usually follows. The permanent cartilages of the first class are more shighly organized, and are not unfrequently found converted into bone which we have frequent opportunities of seeing in the cartilages of the larynx and trachæa; and under these circumstances they become liable to the diseases of bone, as necrosis and exfoliation. We should, however, observe, that the permanent cartilage of the nose, eye and ear, are not liable to this ossific change; but they ought to be considered as belonging to fibro-cartilaginous tissue, of which I shall hereafter speak. *Accidental* formation of cartilage sometimes occurs in different structures of the body, and these have always a tendency to become ossified.

Synovial Membrane.

This structure enters into the composition of all moveable joints, and is for the purpose of secreting a fluid to lubricate their surfaces; but as its use is to obviate the effects of friction, it is also found where tendon or muscle are passing over bones. These membranes form closed cavities without any external opening, accurately adapting themselves, by the attachment of their outer surface, to the parts which they are destined to lubricate; while its internal secreting surface forms the interior of the *joint*, and limits its extent; for of those which belong to muscles and tendons, I shall not speak, until describing those structures. The structures of these membranes seems to be a modification of the common cellular tissue, rendered dense, transparent, and extensible. It is very vascular, and although neither nerves or absorbents have been traced to it, their existence cannot be doubted. In many of the joints it has a tendency to form folds, projecting into the general cavity, and containing small globules of fat between its layers, which, being of a reddish colour, have by some been incorrectly considered of a glandular structure: they seem, however, to be nothing more than formations of fat, for the purpose of adapting more perfectly to each other the parts which constitute the joint.

The synovial capsules of joints do not eorrespond in number to the artieulations, since it is found that one synovial capsule is frequently subservient to several of them.

Synovia.

The seeretion which is produeed by the synovial membrane, is so ealled from its resemblanee to the white of an egg; it is poured out from the extremities of the vessels, which terminate upon the internal surfaee of the membrane; and as this also possesses an absorbent power, the quantity of fluid under ordinary eireumstanees is limited to a healthy standard. When synovia is in a healthy state, it is transparent, of the consistence of albumen, very viscid, and upon being agitated entangles a considerable quantity of air; it is heavier than water, its speeifie gravity being 105. Its ehemical analysis, aecording to Sir Humphry Davy, is as follows:—100 parts of synovia eontain—

98 3	water.
·93	gelatine and mucilage.
·53	albumen.
·23	muriate of soda.
—	traees of fixed alkali and phosphate of lime.
100	

It has been a point of eonsiderable dispute among physiologists, whether the synovial membranes should be ranked amongst the serous or mueous struetures; and indeed this diserepeney appears to depend on the membrane partaking in some respects of the nature of both these systems. It resembles the serous membranes, from its forming a elosed cavity, from its presenting at once a seereting and absorbent surfaee, from its extensibility, and from the manner in which it attaehes itself to the parts that it eovers. It is analogous to the mucous membranes in the eonsistenee of its secretion, and from the pathological fact of its tendency to take the ulcerative rather than the adhesive inflammation. The function of synovia is to diminish the friction of the parts, and consequently to facilitate the motion of bones upon each other.

Practical Remarks.

One of the most frequent effects of inflammation of the synovial membranes, is the abundant secretion of its fluid, distending the joint and producing the disease which is termed hydrops articuli. This disease is sometimes attended with pain; at other times, a considerable accumulation may take place, with little or no inconvenience to the patient. It depends upon the circumstance whether it be a diseased action of the arteries or of the absorbents. In the first case, swelling and pain are invariable symptoms, while in the second, there being no increased action of the arteries, but a disease of the absorbents only, the accumulation occurs without suffering. Similar symptoms attend the accumulation of fluid in the large serous cavities, as the pleura and peritoneum.

The treatment of hydrops articuli must be regulated by the knowledge of these facts:—if there be pain accompanying the disease, thus pointing out that it is the arterial system which is at fault, local bleeding, cold applications, and rest should be enjoined, before any stimulating applications are used; but if, on the contrary, the disease established itself insidiously, the patient suffering no inconvenience beyond stiffness of the joint, then blisters, tartar, emetic ointment, and such medicines and means as stimulate the absorbents, should immediately be had recourse to. But although, as has been mentioned, the synovial capsules both in structure and diseases in many respects resemble the serous membranes, yet it should be observed that inflammation of the synovial membranes produces a change in them, seldom if ever found in the pleura or peritoneum, namely, that of converting them into a thickened pulpy mass, which in some measure fills up the interior of the synovial sac. I shall however, refer my readers to Mr. Brodie's book on diseases of the joints, for a more detailed account of this morbid change. Specific inflammation, as rheumatism, frequently affects the synovial system.

When synovial membranes are wounded they are capable of reuniting. Even new synovial membrane are sometimes formed, both in cases of unreduced dislocations and non-united fractures; in the first, they seem to be produced by the remnants of the former membrane becoming united with the surrounding cellular tissue; and in the second, by the periosteum; in both cases a viscid fluid, more or less like synovia, is secreted by them.

In chronic inflammation the pulpy prolongations, as described by

Mr. Brodie, do sometimes form such adhesions with each other as in a great measure to destroy the motion of the joint, and to produce an amphiarthrodial articulation.

Loose cartilaginous bodies sometimes form in the synovial cavities, more particularly in the knee-joint; they are generally loose within the sac, although occasionally they are fixed. No one has been able to give a satisfactory account of their formation, but it seems probable that they are originally attached to the synovial membrane by peduncles, which are accidentally torn through; they fall into the cavity of the sac, and then are capable of being moved into different positions. When in this state they may be removed.

LECTURE VI.

PHYSIOLOGY OF LIGAMENT.

In order to complete the description of the structures which enter into the composition of a joint, we have now to speak of ligaments, which are strong fibrous bands, passing from one bone to another, and serving to give stability to the connexion of those parts which we have already established, as essential to the formation of an articulation. Ligaments effect this object, either by the direct interposition of a cartilage attaching the two bones to each other, or through the means of a synovial membrane uniting the articular cartilages, which respectively cover the extremity of each bone.

Although the generic term ligament is generally used in the above acceptation, namely, that of a membranous band passing from one bone to another, or connecting different parts of the same bone, yet the term ligamentous tissue is applied also to other structures, which belong to the same system, though they differ in their use, serving the purpose sometimes of forming bands to tie down tendons, as they pass towards their insertions; at others, connecting muscle to bone, under the name of tendon, and again enveloping important organs, as the kidney, &c. We shall confine ourselves at present to the first class, or ligaments connecting bones, as the others will be better understood when speaking of those structures with which they are invariably connected.

The ligamentous tissue connecting bones is composed of firm inelastic fasciculi, of a silvery white colour, arranged in parallel lines, and strengthened by cross fibres, the whole being enveloped by a cellular tissue. Their texture is generally loose and fibrous on their external surface, and acquiring a greater degree of density towards the interior. They vary in thickness, shape, consistence, and adaptation, according to the function and form of the articulation which they strengthen, and the degree of motion which they serve to restrain. They differ also in number, some joints being provided only with a single ligament, while other possess several. The direction of their fibres also varies in the different articulations, but they are always so disposed as to offer resistance in a line continuous with that in which the fibres themselves pursue; or in other words, the extent and variety of motion of which a joint is capable, may be discovered by observing the inclination adopted by the fasciculi of its different ligaments, as they pass from one bone to the other. The ligaments are inseparably united to the periosteum of the bones which they attach, and may indeed be considered as a prolongation of that membrane from one bone to the other. They are both of the same tissue, but taking the name of periosteum where covering bone; but when leaving the bone, it either becomes lined by synovial membrane, or is in contact with articular cartilage, under which circumstance the term ligament is applied to it.

The ligamentous tissue is slightly vascular, but more so than cartilage. On examination, however, numerous blood-vessels are found entering between its fibres ; but these are destined rather for the supply of synovial membrane and the extremities of bones, than for the organization of ligaments themselves. Nerves and absorbents are said to have been traced into ligaments, and the changes which they undergo afford evidence of their existence, although these structures, in a healthy state, possess a very small share of irritability and sensibility. The ligaments contain, in their natural state, a great portion of water, and when dried, become hard, transparent and brittle ; they lose their fibrous texture, and assume a red yellowish colour. They may be reduced to charcoal by fire, and to gelatine by maceration. They are found to contain a considerable quantity of albumen.

In embryo and in infancy, the ligaments are found very soft, and more vascular than in after periods of life; and in old age they become yellow and less brilliant in appearance, and are less flexible and dry. Notwithstanding this tendency of the ligamentous tissue to become dry in old age, it is but little liable to ossify excepting in tendons, which are much subjected to pressure.

Accidental production of ligament frequently occurs in the human body, as may be seen in the formation of new articulations, as well as in the cicatrices of the skin, &c. in which this tissue is produced.

Practical Remarks.

The ligamentous tissue is liable to inflammation, which sometimes terminates in resolution; but at other times it become hardened, thickened, and even ossific matter will sometimes be deposited. Long continued inflammatory action has a tendencey to produce a softened and less tenacious state of the ligamentous tissue, so as to render it incapable of sustaining the common motions of a joint. Fungoid disease generally commences from this tissue, as may be frequently observed from the dura mater, and from the fasciæ covering the long muscles, or from the periosteum. When ligaments are torn through, they are capable of reuniting, as may be seen in cases of rupture of the tendo Achillis, after which accident, if the ends be kept immovable and in contact, an agglutination takes place, and an organic union results, which although at first is more extensible than the tendon, it acquires in time the tenacity of the original structure.

Articular Ligaments.

I shall now particularly treat of that class of the ligamentous tissue, which serves in particular to attach the bones to each other, in the formation of joints. Articular ligaments maintain the bones which they connect in their relative position, restrain and limit their motion one upon the other; they are also sometimes for the purpose of filling up vacancies in bones, and affording an expanded surface for the attachment of muscles. These divisions may each be considered as assisting more or less in the functions of joints.

In the arrangement of articular ligaments, I shall divide them into *seven classes*, as it is clearly seen they somewhat differ from each other in their form, situation, structure, and use.

In the *first class*, I shall describe the capsular ligaments, which are found belonging to some of the moveable joints: they have their edges attached around the articular margins of the two bones which they serve to connect; they thus enclose the articular cartilages, and are lined internally by the synovial capsule. These ligaments are strong and fibrous, in proportion to the degree of motion enjoyed by the joint which they enclose, and obtain further stability in particular parts, either by their additional thickness, or by the passage of muscle or tendon over their surface, where greater strength is required. There are only two perfect capsular ligaments in the body, one belonging to the hip, and the other to the shoulder-joint.

The *second class* comprehends those which run in bands over joints, and are named according to their situation, with respect to the articulation, anterior, posterior, or lateral. Several of these generally belong to one joint, and are loosely connected with each other by irregular fibres, so as to form an imperfect capsule: we have specimens of such in the knee and ancle-joints. Some of the ligaments of this class, in passing to their insertion, wind around a bone in the form of a ring, and in this manner unite a neighbouring bone; this may be seen in the coronary ligament of the radius, and the ligament proper to the atlas.

The *third class* is found in those immoveable joints, where the union between the bones is established by means of one intervening cartilage, and consists of short strong fibres, passing in an irregular manner from one bone to another, so arranged, indeed, as to be best adapted to furnish strength and prevent motion. Instances of this class are found in the sacro-iliac and pubic symphysis.

The *fourth class* are those which exist within joints, or, more properly speaking, between the articular surfaces of the bones, and consequently nearer to the centre of motion. They are surrounded by a reflection of the synovial capsule, to which, however, they are always external. Such are the crucial ligaments of the knee, and the ligamentum teres of the hip-joint. They are properly called the interarticular ligaments.

The *fifth class* comprehends those ligaments which are not only for the purpose of connecting bones, but assist in forming a surface for the reception of the articular face of a bone, as in the ligament extending from the os calcis to the os naviculare. Its particular use is to prevent violent concussion, which must inevitably have occured, had the astragalus been received wholly upon the unyielding structure of the os calcis.

The *sixth class* includes those ligaments whose points of attachment become widely separated from each other, during the different motions of the bones which they connect, and which require therefore elasticity, as well as flexibility, to enable them to recover their form when in the quiescent state. By this property of elasticity, they diminish the necessity for muscular power. The bony arches of the vertebra are connected by this structure, which becomes elongated when the spine is flexed, and by its elastic power assists in bringing the separated spinous processes again together, thereby producing an erect posture of the body.

The *seventh class* consists of those ligamentous fibres, which either serve to fill up an opening in one bone, or to connect bones to each other, without entering into the composition of a joint: they answer the double purpose of giving strength and affording a surface for the attachment of muscles. The ligamenta obturatoria, and interossea, constitute examples of this class.

All these classes, more or less, resemble each other, in being much longer and broader than they are thick.

Practical Remarks.

Articular ligaments are, from their situation and use, very liable to be distended beyond their natural limits, which extension is calculated to excite inflammation, constituting the affection commonly denominated sprain; and which, under ordinary circumstances, it is very difficult to subdue: rest is perhaps to be considered as the best means of cure; and this can only be ensured by applying splints upon the affected joint, so as entirely to prevent its motion. A specific inflammation also sometimes attacks these ligaments, as is seen in gouty and rheumatic diatheses. Inflammation gives rise to two different effects in the ligaments, sometimes in their becoming so altered in their structure and texture as to lose the power of offering sufficient resistance, as to restrain the motions of a joint; and at others, it is found to undergo accidental ossification, which is most frequently observed in scrofulous patients.

LECTURE VII.

FIBRO-CARTILAGINOUS TISSUE.

The fibro-cartilaginous tissue partakes equally of the physical properties, structure, and texture of the fibrous and cartilaginous systems, possessing the flexibility of the one and the elasticity of the other, thus rendering it impossible to class it with either of those systems; but it should rather be considered as a link between the two.

Fibro-cartilage is composed of true cartilage, placed in the intervals of a densely interwoven fibrous tissue: the former gives to fibro-cartilage, whiteness, smoothness, and elasticity; while the latter imparts to it the fibrous and metallic appearance of ligament, as well as flexibility.

This tissue is found in three different situations in the human body; *first,* in the formation of important organs, as in the alæ of the nose, the external ear, the eye-lids, and the trachæa: *secondly,* entering into the composition of joints: and *thirdly,* lining grooves and forming sheaths, for the passage of tendons to their insertions. These three classes, although very similar in appearance, yet differ in their form, chemical composition, and physical properties, possessing more or less elasticity and flexibility, according to the function the organs they enter into the composition of have to perform.

In the *first class,* where they form part of the ears, nose, &c., they are found expanded, so as to be considered by Bechat as worthy of being termed "fibro-cartilaginous membranes;" but they are truly belonging to this system, being composed both of cartilage and ligament; but differently disposed, and evidently in different proportions to this tissue, in other parts of the body; for in these situations they are covered by a membrane termed perichondrium, which may be considered as forming the fibrous portion of their structure, and enclosing the cartilaginous tissue; and further, by boiling, they do not yield so much gelatine as other fibro-cartilages.

The *second class*, or articular fibro-cartilages, are found in two kinds of joints; in the one they are found free, not being connected with articular cartilages, but separated from the bones of the articulation to which they belong by the synovial membrane, which these fibro-cartilaginous bodies divide into two perfect sacs; these are found in such situations, where they are much exposed to violent motion. The other kind are fixed in a solid manner to the bones themselves, as in the vertebræ; and admit of the motion of these bones upon each other, from the physical properties they possess of flexibility and elasticity: they are alike, however, in being firm, resisting, dense, and intricately interwoven, so as powerfully to resist injury. This is exemplified by the strength with which the vertebræ are attached, and by the difficulty of breaking or otherwise destroying the interarticular structures of the jaw and clavicle; and also by the resistance which they oppose to luxations.

The *third class*, which have been described for the purpose of facilitating the motion of tendon, seem to proceed from the periosteum, which probably furnishes its fibrous structure, while the bone itself supplies the interstices of this ligamentous tissue with cartilage, and thus forms the fibro-cartilages which enter into the composition of tendinous sheaths.

The following observations will exemplify the use of this tissue in its three different situations: in the ear, nose, and trachæa, &c., it affords a structure capable of assuming that determined form best adapted to the functions of the organ to which it belongs, while at the same time this form is capable of change from the influence of muscles, while its elasticity allows it spontaneously to reassume its original character, when no longer under the influence of muscular action. Its elasticity is further illustrated by the readiness with which the symmetry of these parts is restored, after contortion produced by the formation of abscess, tumour, or any cause subjecting them to pressure.

The second class, or the articular fibro-cartilages, seem destined, from their elasticity, to prevent concussion of the bones; from their flexibility, to admit of the motions of the joint; and from the density of their texture, to afford strength and security. We find them separating the synovial membrane into two distinct sacs, in such joints where they are for the purpose of increasing the extent of motion, and in a manifest degree adding to the stability of the articulation. The tempero-maxillary, the sterno-clavicular, the inferior radio-ulnar articulations, offer the best examples of these cartilages; but there may also be added the semilunar cartilages of the knee-joint, which may be considered as an imperfect specimen, as they are two in number; and instead of completely separating the bones, and dividing the joint into two synovial cavities, merely project into the articulation, and are covered on both surfaces by the same synovial membrane. If, however, we consider these two semilunar cartilages as forming one complete cartilage of a circular form, we shall then find that they bear a strong analogy to a variety which occasionally takes place in the more perfect joints of a similar character, namely, where an opening is found to exist through the interarticular cartilage, which forms a communication between the synovial capsule of the one side and that on the other; or in other words, by allowing a continuity of the lining membrane, throws into *one* what would otherwise be *two* shut cavities, distinctly separated from each other.

But it is not only in the moveable joints above described that we find the existence of this second class of fibro-cartilage, since it is likewise employed for the purpose of connecting bone immediately with bone, under those circumstances where considerable motion is required, together with great strength, and a capability of resisting violent concussions, united with a tendency to resume its original form after having been either compressed or drawn out by muscular action, or any other mechanical force. All these qualities are admirably combined in the fibro-cartilage connecting the bodies of the vertebræ, generally called the intervertebral substance; and their utility is beautifully illustrated by the easy flexibility which the spinal column enjoys, supporting at the same time the whole weight of the trunk, and bearing the shock of every concussion which the body may receive. We may here observe, that this last mentioned structure bears a great resemblance to that class of *true* cartilage which we described as connecting bone to bone, in the formation of the pelvis, &c.; and, indeed, this gradual assimilation of one structure to another, will be found to pervade the whole body, and renders classification proportionably difficult. We would, however, distinguish the two kinds by observing, that the one allows a manifest degree of motion and compression, while the other suffers only a slight and insensible yielding to take place; that in the former, fibrous tissue, and in the latter, the true cartilaginous structure is found to predominate.

Concerning the use of the third class of fibro-cartilage, nothing farther need be said, except, that by lining grooves and depressions, they form smooth and somewhat yielding structure for the tendons to play over, and are in most places prolonged into sheaths, which bind down the tendons, and prevent them from starting from the bone during the action of the muscles. These sheaths are lined by synovial membrane, which connects them to the tendons passing through.

Organization of Fibro-Cartilage.

Besides the two fibrous and cartilaginous tissues, we find entering into its composition cellular membrane: this is, however, but so little in quantity, and so intimately connected with the two former tissues, that it is very difficult to separate them; but by maceration the three structures are rendered perceptible.

The fibro-cartilaginous tissue possesses but little vascularity in the healthy state; although under inflammation, in which it participates in common with contiguous surfaces, we find it injected with red blood. Nerves nor absorbents have not as yet been traced to it.

Practical Remarks.

This tissue seems to possess but few of the vital properties, and in a healthy state it has neither sensibility or animal contractility: the former, however, developes itself under inflammation. Even those phenomena of life which it does possess, are remarkable for the slowness of their developement: the extreme difficulty of reunion after division, and the rareness of idiopathic disease affecting fibro-cartilage, fully proves this position. In thoracic and abdominal aneurism, it is not uncommon to find the bodies of the vertebræ partially or wholly destroyed, without a corresponding change of the intervertebral substance. In fact, it may be said, that there is no structure in the human body so little liable to disease as this tissue. In some situations in the human body, fibro-cartilage has a tendency to become bone at certain periods of life, as may be observed in the stylo and thyro-hyoideal ligaments; even the sesamoid bones, strictly speaking, are of this nature. This phenomenon has induced some physiologists to divide fibro-cartilages into two classes: namely, permanent and temporary.

Accidental formations of fibro-cartilage sometimes occur after fractures, instead of the production of that temporal cartilage which is necessarily converted into bone; thus producing a supernumerary amphiarthrodial articulation.

In old age this tissue gradually loses its elasticity, and hardens so as to be rendered less yielding and flexible, and consequently more prone to suffer from external injury.

Ossification never occurs in the fibro-cartilages of the ear, eye-lids, or nose.

LECTURE VIII.

GENERAL ANATOMY OF ARTICULATIONS.

By an articulation, or joint, is meant the union of two or more bones, by some intervening medium of connexion, differing in structure from the bones themselves; and when they are represented as thus retaining the different portions of the osseous system in their relative situations, the whole is said to form a natural skeleton.

The classification of bones, according to their size and shape, and their anatomical description, has already made us acquainted with the precise points at which they become connected with each other. It is a general rule that long bones meet at their extremities, flat bones at their edges, and the short bones at different points of their surfaces. The shape and configuration of the different processes of bones, which thus become contiguous, is a most important consideration in the study of joints, as on that depends, in a great measure, both the function of the articulation, and its liability to injury. Moreover, we shall always find a certain degree of correspondence between the articulatory surface of the bones and the other structures concerned in their union.

The uses of joints are either to allow of a positive and evident motion between the bones which they connect, or merely to permit such a relaxation or yielding, as may take off the injurious effects of concussion or accidental pressure.

The parts which enter into the composition of articulations, consist of all those structures hitherto described in these lectures: namely, *bone, cartilage, fibro-cartilage, synovial membrane,* and *ligaments.* The only one of these structures, however, which is essential to every joint, is bone; and the bones may be connected by a fewer or greater number of the other tissues, according to the office which the joint has to perform.

Generally speaking, a joint is the more perfect, and enjoys a greater variety and extent of motion, in proportion to the number of these structures included in its formation. Thus, in the most perfect and moveable articulations, we recognise bone, for the purpose of affording firmness; cartilage, to give elasticity; synovial membrane, to obviate friction; and ligaments, to bind the whole together and prevent dislocation. On the other hand, in those joints where no positive motion is allowed, we find that the bones are merely connected by an intervening cartilage, either with or without ligament.

These observations will naturally suggest the division of the articulatory system into two kinds,—the *moveable* and the *immoveable*. The former is best exemplified in the extremities; while the latter is employed in the junction of such flat bones as enter into the composition of osseous cavities, as the head and the pelvis. As, however, the human body furnishes instances of every possible gradation, between the highly moveable and that which is possessed of scarcely a perceptible yielding, we generally add a third kind of joint, as a connecting link between the two, and partaking of the nature of both: we shall therefore distinguish three species of articulation:—the *diarthrosis*, or moveable, the *synarthrosis*, or immoveable, and the *amphiarthrosis*, which is of an intermediate or mixed character.

The first of these generally includes in its formation all the tissues which have been enumerated as belonging to joints; the second is furnished with only a limited number; while, in the third, the union of the bones is generally accomplished by means of fibro-cartilage. This correspondence between the different species, and their respective structures, will not be found to hold good in every instance, as it is liable to exceptions, which will be noticed when speaking of the joints individually. We shall now proceed to particularize the three divisions.

Diarthrosis.

This is the most moveable articulation of the whole, and connects all the bones of the extremities to each other, as well as the extremities themselves to the trunk. In a diarthrodial joint, the articulatory surface of each bone is covered by cartilage ; it is lined by synovial membrane, and the whole strengthened, more or less, by ligament. It is in some joints of this class that the interarticular cartilages occur. Diarthrosis is subdivided into four species, characterized by the shape of the articulatory surfaces of the bones, and the consequent motion which the joint allows. These are *enarthrosis, arthrodia, ginglimus,* and *trochoides.*

Enarthrosis is where the rounded head of the one bone is received into a corresponding cavity in the other, rendering it capable not only of motion in every possible direction, but of rotation on its own axis. This is, therefore, the most moveable of all articulations. Numerous specimens are to be met with, differing from each other according as the cavity is deep or shallow : the former is well illustrated by the hip, the latter by the shoulder-joint. The degree of motion is regulated, not so much by the depth of the socket as by the adaptation of the ligaments and the surrounding muscles.

Arthrodia is formed by the approximation of two plane, or nearly plane articulatory surfaces, covered by cartilage and synovial membrane: this constitutes the most immoveable joint belonging to this class, as the bones are only allowed to glide slightly one upon the other. An assemblage of contiguous small bones are generally united in this manner, and produce a combined rather than an individual motion : take for example the carpus and tarsus. It is difficult to draw a line of distinction between the true arthrodial and the most shallow forms of the enarthrodial joints.

Ginglimus.—In this species we observe a convexity of one bone received into a corresponding concavity in the other. Both articulatory surfaces are lengthened laterally ; and the sides of the joints are so secured by processes of bone, or strong bands of ligament, as only to allow of motion in a backward and forward direction; or, as it is generally termed, of flexion and extension. This articulation enjoys considerable extent of motion, but it is limited as to direction. Examples are met with in the elbow, knee, and ancle.

Trochoides is when a projecting process of bone is received into an articulatory cavity, formed partly by bone and partly by ligament, where it performs a rotatory motion on its own axis; as we see the dentiform process of the second vertical vertebra rolling within the atlas, or the neck of the radius confined by the coronary ligament.

Thus it will be seen that although similar structures are employed in the formation of all diarthrodial joints, yet they vary in a most remarkable degree, as regards their solidity and the extent and direction of their motion ; and this difference is to be ascribed entirely to the shape of the articulatory surfaces of the bones, and the manner in which the different structures above mentioned are adjusted in their union.

The solidity of these articulations, and their power of resisting injury, is always in an inverse proportion to their mobility. While speaking of the stability of articulations, we should not neglect to observe, that the muscles which surround them afford perhaps a stronger means of defence, and a more efficient power to restrain undue motion, than the ligaments themselves: in fact, a certain balance will be found to exist amongst the muscles, which pass from one bone to the other, over the different surfaces of a joint; so that when those on the one side have drawn the bone in their direction to a certain extent, the antagonizers on the opposite surface exert themselves to prevent a continuation of the same motion. It sometimes happens, however, that under some extraordinary muscular exertion, exercised in a particular direction, this counter-resistance is lost or overcome; and thus bones may occasionally be dislocated by the action of the muscles which move them. These remarks are more particularly applicable to the ball and socket-joints.

Accidental diarthrodial articulations are sometimes produced from the non-union of fractures, or from unreduced dislocations; in the former case giving rise to a supernumerary, in the latter to a supplementary joint.

The failure of union in fractured bones arises either from a want of proper adjustment in the first instance, from improper motion, or from constitutional causes; preventing the usual process which nature sets up to produce union: the fractured extremities then become moulded upon each other; and, by the constant friction which is kept up, their respective contiguous surfaces are rendered perfectly smooth, and capable of gliding one upon the other almost as readily as if they were covered by articular cartilage. They are further surrounded by a fibro-cartilaginous capsule, produced from the periosteum, the internal surface of which secretes a fluid resembling synovia. Wherever the irregularity of the fracture prevents the bones from coming in contact with each other, the interspace is filled up by portions of the same kind of fibro-cartilage as envelopes the exterior of the joint; but these become gradually absorbed, as the friction grinds down the inequalities of the fractured surfaces, and enables them to adapt themselves more completely to each other. Thus the articulation becomes more perfect from motion and use.

Supplementary articulations are found to succeed unreduced dislocations; instances of which most frequently occur in the hip and shoulder-joints. Under these circumstances the head of the dislocated bone, by its pressure, produces absorption of the intervening soft parts covering the bone on which it had been thrown; and, as soon as they are in contact, an alteration takes place in both: the articular cartilage of the one becoming absorbed, and a recipient cavity produced in the other. The head of the bone also becomes flattened, and the new-formed cavity is shallow in proportion. No new articular cartilage becomes deposited in this process, but the contiguous surfaces assume an altered character, being rendered perfectly smooth and hard, as in the former instance presenting an appearance resembling porcelain. A new and very complete capsular ligament is produced, which is lined internally by an imperfect synovial membrane. The old articular cavity, from which the head of the bone had been thrown, being now rendered useless, becomes partly obliterated, much altered in form, and filled up by a fibro-cartilaginous tissue.

Synarthrosis.

Synarthrosis is the name given to those articulations where the bones are joined by a single intervening cartilage, inseparably united to them both, and allowing of a mere yielding, which is greater or less in proportion to the thickness of the connecting structure. It is made use of to unite different portions of bone into one apparently solid fabric; which, by this combination, is rendered less obnoxious to injury than if it had originally consisted of one entire bone. These articulations are strengthened by the periosteum, which passes from one bone to the other; and, in many instances, by ligamentous bands; producing so firm a union, that they can only be separated by the same violence as would fracture the bones.

Synarthrosis is subdivided into several varieties: such as the *serrated* and *squamous suture, harmonia, schindylesis, gomphosis,* and *synchrondrosis.*

The *serrated,* or *true suture,* is where the edges of the bones are dove-tailed into one another, by means of irregular projections and corresponding indentations, which are most prominent at their external surfaces, as is seen in the junction of the parietal bones.

The *squamous,* or *false suture,* is formed by the edge of one bone overlapping that of another, while the two surfaces thus approximated are slightly grooved instead of serrated: for instance, the temporal and parietal bones.

Harmonia constitutes the mode by which most of the bones of the face are united. Here the surfaces are only in juxta position, but present slight irregularities which are fitted to each other; or when two edges are brought together, there is a slight overlapping.

Schindylesis is the insertion of a plate of one bone into the groove of another. The junction of the sphenoid with the vomer exemplifies this species of articulation.

Gomphosis is where a conical portion of bone is implanted into a cavity, corresponding in shape: the only instance of this is afforded by the reception of the teeth into their alveolar sockets. We may here observe, that in all these species of synarthrodial articulation, the intervening cartilage is extremely thin, being hardly distinguishable from membrane: they are likewise all destitute of ligament. They constitute the most solid and immoveable form of union.

Synchondrosis is the term applied to those joints where the union is effected by a strong and thick portion of cartilage, which presents a larger surface externally than internally, and allows the greatest degree of yielding of which this class is capable. Examples of this are found in the sacro-iliac and pubic synchondrosis. The different portions of the same bone in the young subject are also connected in this manner. The term symphysis is frequently used to denote the union of the pelvic bones.

Although we have described the synarthrodial joints as destitute of positive motion, yet the degree of yielding and contortion which they allow, differs materially at different periods of life, and under different healthy and diseased alterations which take place in the body. We may here remark that by the term yielding, we signify that kind of motion which is produced by accidental mechanical pressure, and totally independent of the action of the voluntary muscles; for we shall find no muscles so situated as to produce a change of situation between any two bones connected by this class of articulation.

The synarthrodial joints have a greater and more constant tendency than any of the others, to become firmer and less pliant as age advances. Thus, in the newly-born infant, the bones of the head are widely separated from each other, being merely connected by membrane: they gradually approximate for the developement of suture; and, at later periods of life, consolidate into one continuous mass, to the actual obliteration of suture. This last process always commences from the internal surface, which may be proved by the examination of skulls at certain periods of life, at which the sutures may still be traced on the exterior, although all vestige of them is lost internally.

On the other hand, under disease, the sutures may become extended, as may be seen in hydrocephalus and the synchondroses of the pelvis; or also found to yield and become elongated, under difficult and protracted parturition.

Amphiarthrosis.

The *amphiarthrosis,* or *mixed articulation,* resembles synarthrosis in the manner by which the bones are united, and diarthrosis from the greater extent of motion which is allowed. Fibro-cartilage is the structure employed to effect the union, and the joint thus formed is under the influence of muscular action. The bodies of the vertebræ are connected to each other by this class of articulation, and the motion thus allowed has been already mentioned, when speaking of fibro-cartilage. The connecting structure gradually loses its elasticity as age advances, but the joint is but little liable to become obliterated by a natural process. After some unconsolidated fractures, a species of amphiarthrodial joint is produced, from the fractured extremities of a bone being reunited by an intermediate substance, of a flexible and tenacious texture, which allows them to move one upon the other: such a structure is frequently produced after fractures of the patella, neck of the femur, and olecranon. Indeed, wherever mechanical or constitutional circumstances interfere with the reunion of bone, either a supernumerary amphiarthrodial or diarthrodial articulation is the consequence.

Practical Remarks.

I can scarcely be expected, while treating of anatomy, to enter fully into the detail of the diseases to which joints are liable, having already mentioned the peculiar affections of each structure which enter into their composition: but I shall only urge the necessity of bearing in mind the complicated structure of articulations, the peculiar functions they have to perform, and their consequent liability to morbid affections. I may, however, perhaps with advantage recapitulate, that as bone, cartilage, synovial membrane and ligaments are all necessary to the formation of a joint, and that as each is susceptible from numerous causes to inflammation and its consequences, that the symptoms produced are as various as the structures, and that a thorough knowledge of them can only be gained by a strict attention to the altered function of the affected articulation. I shall, however, make some few remarks with respect to the wounds of joints; and what is first to be considered as most important, is the manner in which the wound was inflicted, and the depth to which it has penetrated; for we find the danger great in proportion to the violence and contusion sustained, and to the depth and extent of the wound, with injury to important parts. When a joint is wounded, the term implies an opening into the synovial cavity, accompanied frequently with injury to the other structures of the joint, as ligaments, vessels, and even sometimes cartilages and bone. When the synovial cavity is opened, it is generally indicated by a flow of the synovia from the wound; but even this, it is to be remembered, does not always point out the actual nature of the case, as the synovia may escape from a bursa mucosa in the vicinity of the injured joint, and not from the articulation itself: hence the necessity of a just anatomical knowledge, by which the surgeon should be enabled to form his judgment, without the necessity of the introduction of a probe, which is so liable to excite inflammation, and to cause therefore more mischief than the wound itself. In these cases the treatment is the same, whether injury to the synovial capsule be proved or only suspected: namely, that the wound be immediately closed by adhesive plaster, that the joint be placed and maintained in a perfect state of rest, that evaporating lotions be applied, and that the antiphlogistic regimen be strictly enforced; and under such treatment, incised wounds of joints do frequently heal favourably, without any dangerous symptoms; as is seen after the operation for removing loose cartilage from joints: but this, however, is not invariably the case; for in some constitutions of a highly inflammatory tendency, the injury is followed by violent inflammation of the synovial cavity, leading to suppuration within the joint, and frequently terminating by the destruction of the cartilages, and even disease of the osseous structure itself. These effects are generally accompanied by excessive constitutional irritation, which often rapidly carries off the patient; or, should his strength of constitution enable him to overcome the consequences of the injury, an anchylosed joint is generally the result. As may naturally be expected, the danger attendant upon wounded joints depends upon the extent of injury as above mentioned, together with the state of constitution and previous habits of the patient. It is by attention to these circumstances that the surgeon is enabled to judge whether or not the patient has strength enough to sustain the attempt at reparation, or whether it be adviseable to remove the limb; the object of the surgeon being, first, to place the life of his patient in security; secondly, to save the limb if possible; and thirdly, to produce anchylosis, with such a position of limb as may render it best fitted to perform its natural functions. After all our attempts, it sometimes happens that anchylosis is not complete, so that some degree of motion is yet allowed in the joint. If the articulation, under these ciacumstances, be one destined to receive the weight of the body, as in those of the lower extremities, and more especially the knee, it becomes constantly subjected to concussion, followed by frequent attacks of inflammation, which, by exhausting the strength and undermining the constitution of the patient, may yet render amputation necessary. I have myself been obliged to amputate a limb under these circumstances.

Loose cartilaginous bodies are not unfrequently found within the cavities of joints. They are most frequently found in the knee-joint; but occasionally occur in the carpal and temporo-maxillary articulations. There are a variety of opinions with respect to the formation of these bodies; but they are probably the result of a specific inflammation of the synovial membrane, producing a deposit which naturally assumes the character of the neighbouring cartilage, but differs from it in having a tendency to become ossified. As long as these bodies remain attached to the synovial membrane, they produce little or no inconvenience; but as soon as from any cause they become separated, they then interfere with the functions of the joint, and render their removal necessary. The danger attendant upon the opening of a joint should lead the surgeon to consider duly the state and constitution of his patient, before he attempts the operation, which should be performed as follows. The loose body being directed by the operator to the situation most favourable for its removal, namely, on the inner side of the patella, should be retained there by the thumb and fore-finger of the operator, while an assistant draws the skin tightly over the patella. An incision should then be made directly on to the body, and of a size sufficient to admit of its extraction. The skin is then allowed to recover its former situation, and thus the wound into the capsule becomes effectually closed. A splint should then be placed behind the knee, so as to retain it in an extended position, and the usual precautions for preventing inflammation adopted and continued until the wound is entirely healed.

LECTURE IX.

DESCRIPTIVE ANATOMY OF ARTICULATIONS.

Articulations of the Head and Spine.

THE sutural connexions of the bones of the head and face having already been spoken of, the only articulation proper to the head which remains to be described, is the *temporo-maxillary.*

Articulation of the Lower Jaw.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

The *inferior maxillary bone* forms a double articulation with the temporal bones, the condyloid processes of the former being received into the anterior division, or fossa condyloidea, of the glenoid cavity of the latter. This cavity is bounded, behind, by the fissura glasseri, which separates it from the fossa parotidea ; and before, by the root of the zygomatic arch, which presents a transverse ridge, marking the extent of its articulatory surface. The glenoid cavity, and that part of the root of the zygoma included in the articulation, are covered by a thin cartilage. The *condyles* of the lower jaw have their long axis from side to side, and are also covered by articular cartilage, presenting a larger surface before than behind: they do not precisely correspond in shape with the glenoid cavity, in consequence of the interposition of an *interarticular fibro-cartilaginous* tissue, which forms a thin layer, transversely oval, presenting a broad superior and inferior surface, which, under the different motions of the jaw, adapt themselves to the surfaces of the two bones.

It is somewhat in the form of a wedge, being thicker behind than before; and into its posterior edge some small arteries may be traced: its centre is always very thin, and is sometimes perforated, forming an opening between the two synovial cavities. Its circumference is attached to the lateral ligaments.

Its *use* is to facilitate and extend the motions of the lower jaw, and partly to give insertion to the pterygoideus externus muscle. This articulation is strengthened by an external and internal lateral, and the stylo-maxillary ligaments.

The *external lateral ligament* is composed of short, thin, parallel fibres, which are united by a dense cellular membrane. It is attached above, by a broad origin, to the articular tubercle and outer edge of the glenoid cavity, and to the anterior edge of the meatus auditorious externus. It extends obliquely backwards, and terminates on the outer side of the neck of the lower jaw: externally, this ligament gives support to the parotid gland; and internally, it is in contact with the interarticular cartilage, and is covered by synovial membrane.

The *internal lateral ligament* is composed of a number of narrow slender fibres, of considerable length, which arise from the inner edge of the glenoid cavity; it passes obliquely downwards and forwards, but immediately divides into two fasciculi: the outer fasciculus, or that one nearest to the bone, is much the shorter, and is attached to the inner side of the neck of the jaw; while the internal, or longer fasciculus, enlarges as it descends, and is inserted into the upper and fore part of the posterior maxillary foramen: its point of insertion is a small spinous process which partly covers that foramen, and, projecting somewhat from the jaw, leaves a space for the passage of the dental artery and nerve, which are thus protected from the action of the pterygoideus internus muscle. The precise situation of this ligament is, first between the pterygoidei muscles, and then between the pterygoideus internus, and the perpendicular plate of the lower jaw.

The *stylo-maxillary*, or *suspensory ligament*. This ligament arises from the styloid process of the temporal bone, passes downwards and a little forwards, and is inserted by rather an extended surface into the angle of the lower jaw, between the fibres of the masseter and pterygoideus internus muscles. This ligament seems to be of as much importance in affording a surface for the attachment of the stylo-glossus muscle, as in connecting the temporal bone with the lower jaw.

The *synovial membrane* gives an internal covering to the two lateral ligaments which I have described, and is also reflected over the cartilaginous surface of the glenoid cavity in the temporal bone, and the condyloid process of the lower jaw. But by the intervention of the interarticular cartilage, this membrane is divided into two distinct synovial cavities: the upper compartment, which is the larger, is situated between the glenoid cavity and the superior surface of the interarticular cartilage; and the lower one is placed between the inferior surface of the cartilage and the condyloid process of the jaw. The synovial membrane is strengthened laterally by the lateral ligaments of this joint; anteriorly, by the tendon of the pterygoideus externus; and posteriorly, by the condensed cellular membrane covering the parotid gland: it is looser posteriorly than in the anterior part.

Motions of the Lower Jaw.

Man being an omnivorous animal, we find that the lower jaw is moveable in various directions, as the different substances on which he feeds require different actions of that part for their complete mastication. It admits of motion downwards, upwards, forwards and backwards, and has also lateral motion.

When the lower jaw is depressed and the mouth opened, we find the condyloid process changing its situation in the glenoid cavity; so that its upper surface is turned forwards upon the root of the zygomatic arch, the angles of the jaw are thrown backwards, and the coronoid processes are thus depressed. The interarticular cartilage, in consequence of the limited size of the inferior synovial cavity, is always in contact with the condyloid process of the lower jaw. The ligaments also undergo an alteration, with respect to the states of relaxation and extension. The external ligament is rendered tense in proportion to the depression of the jaw; and the upper synovial cavity is drawn forwards, which movement its laxity allows; but the membrane between the inferior surface of the cartilage and the lower jaw, remains stationary, as the cartilage and condyloid process move together, in consequence of the firm attachment of the lower part of the ligament.

The stylo-maxillary ligament is relaxed.

The internal lateral ligament is but very slightly affected by the depression of the jaw.

When the jaw is elevated, the condyloid process recedes into the glenoid cavity; and having arrived there, the superior surface turns upon its own axis until the teeth are brought into apposition, when the motion is completed. The position of the ligaments is changed precisely to the reverse of their state in the former motion: viz., the external lateral ligament is relaxed, the stylo-maxillary is extended, the internal lateral does not change its position, and the superior synovial membrane becomes again relaxed.

When the jaw is drawn forwards there is no motion of the hinge, but the whole jaw moves horizontally in advance, so that the condyle and the angle pass simultaneously forwards. In this motion all the ligaments are put upon the stretch, excepting the inferior part of the synovial membrane, which is kept in its relative position, with respect to the interarticular cartilage and condyloid process, by the attachment of the external pterygoid muscle, which is inserted into them both, and keep them in situ.

The motion of the jaw backwards seems to be nothing more than replacing it after it has been drawn forwards by the pterygoid muscles; for in the natural position we find no muscles capable of giving it motion in that direction.

The lateral motion is produced by the condyle of the jaw being carried outwards on the one side, and inwards on the other. This motion is of limited extent, as it is soon opposed by the vaginal process of the temporal, and the spinous process of the sphenoid bone; but some advance may take place of the jaw on one side; in which case, the condyloid process, on that side, passes forwards on the root of the zygomatic process; while, on the other, it acts in the glenoid cavity as the centre of motion; and it is by inordinate degrees of motion in this direction, that dislocation on one side sometimes occurs.

Practical Remarks.

There is but one direction in which the lower jaw can be dislocated: in this case, the condyloid process is thrown forwards and downwards under the zygomatic arch; this displacement is produced by strong muscular action, while the jaw is in a state of complete depression. The mouth is, by the advance of the condyloid process under the zygomatic arch, mechanically kept open, so that the ligaments are much in the same state as in the natural depression of the jaw; unless, from the great degree of violence which has been exercised in producing the injury, the extension be so great as to cause the laceration of the external lateral ligament and superior synovial membrane.

I have never obtained an opportunity of examining the parts by dissection after this accident, except by producing the dislocation *post mortem*, when the muscles are found in the following state. The temporal muscle is subjected to a great degree of extension; and I should think in the living subject, in whom there would be a strong counteracting muscular power, that its posterior fibres would be frequently ruptured from the advance of the coronoid process, into which it is inserted.

The masseter muscle, in consequence of the decussation of its fibres, is, with respect to its anterior and posterior edges, placed under exactly different circumstances; the anterior being relaxed, and the posterior forcibly and painfully extended. The pterygoideus internus is in a complete state of relaxation, the two bony attachments of the muscle being brought closer together. The external pterygoid muscle is also relaxed, in consequence of the condyloid process of the lower jaw being thrown nearer to the sphenoid bone, from which this muscle arises.

A perfect knowledge of the situation of muscles under dislocation, is quite essential to every medical practitioner, in order that he may be enabled to point out the best mode of reduction, by relaxing those muscles which are put upon the stretch. Nor are frequent opportunities of observing these accidents necessary for the acquisition of such knowledge, because accurate observation of the ordinary functions of the muscles will enable the practitioner to perceive their unnatural state under dislocation. In proceeding to reduction it should be borne in mind, that the action of muscles will present the only obstacle in a case of recent displacement. Thus, in reducing the dislocation of the jaw, the object is by force to depress the condyloid process below the zygoma, and by pressing it backwards, cause the posterior fibres of the masseter and temporal muscles to draw it into the glenoid cavity. In the subsequent treatment of this case, where we have reason to suspect the laceration of muscular fibre, the jaw should be kept closed as much as possible, to afford the best chance for their perfect reunion.

Displacement of the lower jaw, as has been already observed, sometimes happens only on one side; but the mode of reduction, and the ulterior treatment, do not differ from the plan laid down in cases where both sides are dislocated. The difference between the two accidents is so strikingly obvious to the most cursory observer, as to render it quite unnecessary for me to make any remarks on the diagnostic symptoms.

Articulations of the Vertebral Column.

From the number of bones which enter into the formation of the spine, its ligaments must necessarily be numerous and complicated. They may, however, to facilitate their description, be divided into two distinct sets: those which are common to all the vertebræ, and those which only appertain to particular bones of the column. I shall first describe the ligaments *common* to the articulations of the spine.

Articulations common to the Vertebræ.

All the vertebræ are connected by ligaments at their *bodies*, at their *articular, transverse, spinous processes*, and also at their *bony arches*. The articulation of the bodies of the vertebræ is effected by the common anterior and common posterior vertebral ligaments, and by an intervertebral substance.

Articulation of the Bodies of the Vertebræ.

CLASS *Amphiarthrosis.*

The *common anterior vertebral ligament* originates at the lower edge of the anterior portion of the circular ligament, on the upper part of the second cervical vertebra, and extends to the sacrum, varying in breadth and thickness in its descent. It is thin and narrow on its cervical vertebræ, thicker and wider on the dorsal, and again attenuates; but it is at its greatest breadth in the lumbar region. It is composed of numerous distinct longitudinal fibres, which are separated for the transmission of blood-vessels. This ligament expands itself more widely over the intervertebral substance than in its passage over the bodies of the vertebræ. Its anterior surface through the cervical region is covered by the pharynx and œsophagus; on the dorsal, by the œsophagus, aorta, thoracic duct, and vena azygos; and on the lumbar, by the aorta, vena cava, and the receptaculum chyli. Its posterior surface is in contact with the vertebræ themselves and with the crucial ligaments, and is also laterally connected with the longus colli muscle. If the common anterior ligament be raised from the intervertebral substance, small *decussating* fibres may be seen passing from the lower edge of the vertebra above, to the upper edge of the vertebra below, crossing each other as they pass; from which circumstance they have been termed the *crucial ligaments.* The common anterior vertebral ligament has the shining metallic lustre of the fibrous system generally: it is composed of a superficial and deep layer of fibres; the latter being firmly connected with the vertebræ themselves, while the former are strengthened in the cervical region by the tendinous origin of the muscles of the neck, and in the loins by the crura of the diaphragm, so as to add much to its strength in the most moveable parts of the vertebral column.

Common posterior vertebral ligament.—This ligament is usually described as arising from the lower part of the second cervical vertebra; but that portion which, by some anatomists, is called the perpendicular ligament of the dentiform process, is in fact the commencement of the common posterior vertebral. It takes origin, therefore, from the upper and fore part of the foramen magnum, and the concavity of the basilary process of the occipital bone, descending from thence within the vertebral canal on the posterior surface of the bodies of the vertebræ, to the sacrum. It first passes behind the odontoid process, and extends laterally in its passage over the posterior surface of the intervertebral substance. None but minute vessels can be traced to it, nor is its structure so fibrous as that of the common anterior ligament. In the cervical and dorsal regions, it is thicker than in the lumbar. The posterior surface of this ligament is in contact with the dura mater, covering the spinal marrow, to which it is connected by loose cellular membrane. The anterior surface is attached to the bodies of the vertebræ and to the intervertebral substance, and is very firmly connected with the latter. Its lateral edges are parallel to the sinus venosus. This ligament prevents the spine from being bent too much forward.

Intervertebral substance.—The structure of this substance partakes of the nature of ligament and cartilage; it occupies the spaces between the bodies of all the vertebræ, corresponds in shape with the bodies of those which it connects, and, like them, differs in the different regions, gradually increasing in density, and separating the vertebræ more widely as it approaches the sacrum. In the cervical and lumbar regions, this substance is found thicker anteriorly than posteriorly; while, in the back, it is thinner anteriorly; thus accommodating itself to the natural curvitures of the spine. It is composed of oblique concentric lamellæ, which are stronger in the external circumference than in the centre, where it is almost fluid; it has, therefore, so little compressibility, as to allow the free motions of the vertebræ upon one another, as if they moved upon a pivot; and, at the same time, diminishes concussion under the violent motions of the spine. It is closely attached, at its edge, to the bodies of the vertebræ; and is so elastic, that man loses somewhat of his height, towards evening, from the pressure to which this substance is subjected in an erect posture during the day. Its strength is such, its attachment so perfect, and its resistance so great, that it will allow even bone to give way rather than yield itself to the application of force. Its anterior surface is in contact with the common anterior vertebral ligament, with which it is firmly connected; laterally, with the interarticular ligament of the ribs; and posteriorly, with the common posterior vertebral ligament. In old age, this structure becomes dry and shrivelled, so as to diminish the height of the person; and it also, in a great measure, loses its flexibility. The combined flexibility and elasticity of this structure admits, at the same time, both the variety of motion and strength of the spinal column.

Mode of Connection of the Arches of the Vertebræ.

The bony arches of the vertebræ do not form articulations with each other, but are connected by means of a very elastic ligamento-cartilaginous structure, which fills up the spaces between them, and allows of extensive motion between one arch and another. The first of these ligaments is found between the second and third cervical vertebræ, and the last between the fifth lumbar and the first bone of the sacrum. It is divided into a right and left portion by some intervening cellular membrane, but united at an angle posteriorly near the base of the spinous processes. In the fœtus this ligament is separated into two distinct portions, which probably do not unite until the ossification of the spinous processes has been perfected. It differs from all other ligaments in being extremely elastic, and capable of resisting an extraordinary degree of force. Its anterior face is in contact with the dura mater of the medulla spinalis; posteriorly it is of a reddish tint, and is with difficulty perceived without producing flexion of the spine, in consequence of its being so much covered by the arches of the vertebræ, particularly in the dorsal region. These ligaments are very strong, short, and of a yellowish red color; possessing such a degree of elasticity, as to assist the muscles in recovering the erect posture after the spine has been flexed.

Articulation of the Articular Processes.

Class *Diarthrosis.*—Subdivision *Arthrodia.*

The faces of the articular processes are covered with cartilage, and are connected by synovial membrane, which forms a very small capsule, and secretes but an inconsiderable quantity of synovia. On the exterior there are some ligamentous fibres, which connect the processes more firmly together, and produce an irregular capsular ligament, which is more visible in the dorsal and lumbar than in the cervical region. The inner edge of this capsule is connected with the ligamentum subflavum.

Cervical ligament.—The cervical ligament arises from the perpendicular spine of the occiput, and is inserted into the spinous process of the five superior cervical vertebræ. It is much stronger in quadrupeds than in man; as, from their horizontal posture, such a structure is essentially necessary to support the weight of the head. In man it appears to be of little more use than to give attachment to muscles, although it may, in some degree, assist in maintaining the proper position of the head in the erect posture.

Interspinous ligaments.—These ligaments extend from the apex of one spinous process to that of another, and are situated immediately under the skin. They commence at the sixth cervical vertebra, and extend as far as the sacrum.

Laterally they intermix with the tendinous origin of the trapezius and latissimus dorsi muscles. These ligaments are sometimes described as occupying a considerable portion of the bodies as well as the apices of the spinous processes; but it appears that the structure in that situation is merely the tendinous origin of muscle.

In the dorsal vertebræ there are some fibres of ligamentous appearance, situated between the transverse processes, which have been called *intertransverse* ligaments, but which do not deserve such a classification, as they seem rather to be the origin of the levatores costarum and multifidæ spinæ than proper ligaments.

The Peculiar Articulations of the Vertebræ.

Articulation of the Head with the Vertebral Column.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

This articulation forms a double arthrodial joint, produced by the condyloid processes of the occiput being received into the articular surfaces of the atlas; both of which are covered with cartilage and synovial membrane, and are connected by the following ligaments, which retain them firmly in their situation.

The *anterior portion of the circular ligament* is attached above to the fore part of the foramen magnum, and extends itself to the anterior extremities of the condyloid processes; it thence passes down and is inserted into the fore part of the arch of the atlas, becoming there continuous with the common anterior vertebral ligaments, and also into the edges of the articular surfaces of that bone.

Posterior portion of the circular ligament.—This ligament is much larger than the anterior; it arises from the posterior margin of the foramen magnum, extending itself laterally as far as the capsular ligament, connecting the occiput with the atlas, and then passes down to be inserted into the upper part of the posterior arch of the atlas. This ligament has in contact with its posterior surface, the straight and superior oblique muscles of the head, the vertebral arteries, and sub-occipital nerves.

The *capsular ligaments,* which strengthen the articulation of the condyles of the occiput with the atlas, are attached to the circumference of the articular processes of both these bones; they are looser anteriorly and posteriorly, than at the sides, and allow therefore but of little lateral motion.

The *synovial membrane* covers the occipital condyles and articular processes of the atlas, lining at the same time that part of the internal surface of the anterior and posterior circular ligaments, which is in contact with those portions of bone, and thus assists in forming the capsular ligaments, for the more perfect security of this articulation. The synovial membrane is also attached, on its inner side, to the transverse ligament of the atlas.

Connexion of the Vertebra Dentata with the Occiput.

These bones are not in actual contact so as to form a joint, but they are kept in their relative situation by the *two lateral* or *alar ligaments,* which arise connected with each other from the body and sides of the odontoid process, reaching as far as its apex; from which point they pass on either side upwards and outwards, to be inserted between the inner edge of the condyloid processes and the foramen magnum of the occipital bone. They are for the purpose of preventing the head with the atlas being rotated too forcibly and extensively upon the vertebra dentata.

Articulation of the Atlas with the Vertebra Dentata.

Class *Diarthrosis.*—Subdivision *Trochoides.*

The ligaments which form the articulation between the atlas and the second cervical vertebra, or the vertebra dentata, are *first,* the transverse ligament, which is proper to the atlas; and *secondly,* the ligaments of the articular processes, which are common to all the vertebræ.

The *transverse ligament* arises from a rough tubercle on the inner side of the articular process of the atlas; then forming an arch, which encloses the odontoid process of the second cervical vertebra, by passing behind it, is directed transversely, to be inserted into the inner side of the opposite articular process. The middle fibres which are in contact with the dentiform process, are the strongest; and from this part two appendices issue; one placed superiorly and the other inferiorly; the superior one, passing along the odontoid process, is lost just above its apex in the fibres of the common posterior ligament of the vertebræ; the inferior appendix arises from the inferior edge of the transverse ligament, passes downward in connexion with the lower part of the odontoid process, and is also imperceptibly lost amid the fibres of the common posterior vertebral ligament. The transverse ligament, together with the appendices, form a cross; between the anterior part of which, and the odontoid process, is a *synovial membrane,* which is sufficiently loose, to allow of free rotatory motion between the first and second cervical vertebræ. There is also a synovial membrane covering the cartilaginous surfaces, upon the fore part of the odontoid process and arch of the atlas.

The capsular ligaments connecting the articular surfaces of these bones need no further description, as they have already been mentioned amongst those common to the vertebræ.

Motions of the Spine.

With respect to this function of the spine, there are three ways in which it may be considered. *First,* its general mobility as a whole; *secondly,* the peculiar motions of each region; and *thirdly,* the mobility which exists between any two particular vertebræ.

The general motions of the vertebral column are those of *flexion, extension, lateral inclination, circumduction,* and *rotation.* The most extensive motion of which the spine is capable, is *flexion;* for although the degree of motion between any two vertebræ is extremely limited, still, as that motion is multiplied by the number of vertebræ, the flexibility of the whole column becomes very considerable. The lower extremities being fixed, the abdominal muscles draw the ribs forwards and downwards, and the whole trunk is bent, so as to form a parabolic curve. In this action the common anterior ligament is relaxed, the fore part of the intervertebral substances is compressed, while their posterior edges are stretched; and the common posterior ligament of the vertebræ, together with the interspinous ligaments, are in a state of extension.

In *extension,* the ligaments are placed precisely in the reverse state to that which they assumed in flexion; those which were extended being in their turn relaxed, while the common anterior vertebral is now put upon the stretch: this motion is more confined than that of flexion, in consequence of the spinous processes of the dorsal vertebræ being soon brought into apposition, in which state no farther extension is possible.

In the *lateral inclination,* the intervertebral substances are compressed on that side to which the body is bent; the other ligaments are scarcely altered from their natural state; as the motion, being restricted by the resistance which is offered by the ribs, and the transverse processes of the vertebræ, is too inconsiderable to affect them.

Circumduction is produced by the succession of the other motions, so that the ligaments undergo the changes peculiar to each motion, as rapidly as it occurs.

The *rotatory* motion of the spine is very limited in all the vertebræ, but more particularly in the dorsal, in consequence of their attachment to the ribs. In this motion the intervertebral substance is contorted, as are likewise all the ligaments.

All the motions of the spine are capable of being aided to a great extent, by the motion of the pelvis upon the thighs.

Motions peculiar to each Region.

The extent of motion in the several regions of the spine, is in proportion to the thickness of the intervertebral substance; it is, therefore, much greater and more extensive in the cervical and lumbar regions than in the dorsal, in which it is not only impeded by the comparative tenuity of this substance, but also by the oblique directions of the spinous processes of these vertebræ, and their attachment to the ribs. The reason for the stability of this region is obvious, when we consider the important organs which the dorsal vertebra assist in enclosing, and that extensive motion would necessarily interfere with their functions.

Motions between particular Vertebræ.

The free motion of one vertebra on another is particularly exemplified in the first and second cervical. The occiput is so articulated with the atlas, that flexion, extension, and, in a slight degree, lateral motion, are allowed between them; but if there be necessity for these motions to any extent, the whole of the cervical vertebræ participate in them. It is, however, in the rotatory motion of the head, that the first and second cervical vertebræ act upon one another; and the species of articulation formed by these two bones shews how well they are calculated for that purpose, and how essential they are in the performance of most of the animal functions: for they may justly be said to increase and regulate the powers of *vision, smell,* and *hearing;* and by shortening and prolonging the trachea, alter the tones of the voice, and assist in producing a free passage of air to and from the lungs.

Practical Remarks.

The number and breadth of the attachments of these bones,—their firm union by ligament,—the strength of their muscles,—the very inconsiderable degree of motion which exists between any two of them,—and lastly, the obliquity of their articular processes, especially in the dorsal and lumbar vertebræ, render dislocation of them, at least in those regions, impossible without fracture; and I much doubt whether dislocation even of the cervical vertebræ ever occurs without fracture, either through their bodies or their articular processes, although Boyer mentions cases of dislocation of the atlas from the vertebra dentata, and has even described the means to be employed for reduction.

The effects of such an accident, whether with or without fracture, would produce precisely the same injury to the spinal marrow, and symptoms of greater or less importance, according to the part of the spinal column that is injured. Death is the immediate consequence, if the injury be above the third cervical vertebra, the necessary paralysis of the parts to which the phrenic and intercostal nerves are distributed, causing respiration instantly to cease. If the injury be sustained below the fourth cervical vertebra, the diaphragm is still capable of action, and dissolution is protracted ; the symptoms, in fact, are less violent in proportion as the injury to the spinal marrow is farther removed from the brain; but death is the inevitable consequence, and that in every case, at no very distant period. Indeed, the diagnosis and prognosis are the same as have been described in speaking of fractures of the vertebræ.

Articulation of the Ribs with the Bodies of the Dorsal Vertebræ.

Class *Diarthrosis.*—Subdivision *Ginglimus.*

In the osteological description of the dorsal vertebræ, all excepting the first, tenth, eleventh and twelfth, are said to have a half articular surface on the upper and lower part of their bodies, for the head of a rib, which is furnished with two corresponding half articular surfaces, separated from each other by a small perpendicular ridge: each surface is covered by cartilage. They are surrounded by a synovial membrane; and the following particular ligaments connect them firmly to the vertebræ.

Anterior ligament of the head of the rib.—This ligament surrounds the anterior part of the head of the rib, and then, in all excepting the first, eleventh, and twelfth, divides itself into three orders of fasciculi; one passing upward to the articulation of the rib with the vertebra above, another passing to the vertebra below, and the third and central fasciculus attaching the rib to the intervertebral substance: thus every rib is firmly attached to two of the vertebræ, and to the intervertebral substance. The anterior face of this ligament is covered by the thoracic ganglia of the sympathetic nerve, and by the pleura; on the right side also, by the vena azygos; and, posteriorly, it is in contact with the synovial membrane of the articulation of the ribs with the vertebræ, for which it forms a capsule.

The *interarticular ligament* enters into the articulation of all the ribs, from the second to the tenth inclusive, and is apparent on raising the middle fasciculus of the former ligament. It arises from a small tubercle situated between the two articular surfaces on the head of the rib, and passes to be attached to the intervertebral substance.

The *synovial membrane* is reflected upon the half of the articular surface of the rib and vertebra, both above and below, forming two distinct bags, which are separated by the interarticular ligament. Their synovial secretion is very limited.

Articulation of the Tubercle of the Rib to the Transverse Process of the Vertebra.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

This joint exists in all the ribs excepting the eleventh and twelfth, and is formed by the contact of these two parts, both of which are covered with cartilage. They are furnished with a small synovial cavity, which secretes more synovia than that of the preceding articulation. The following ligaments concur in fortifying this joint.

The *external transverse ligament* arises from the apex of the transverse process of each dorsal vertebra, and passes outwards to be inserted into the neck, reaching as far as the angle of each rib. These ligaments gradually increase in size as far as the ninth rib, which is the longest from its tubercle to its angle, and is composed of fasciculi of great strength. With regard to the twelfth rib, the ligament passes obliquely downwards, to be inserted into its body; serving, by this attachment, to connect it with the transverse process of the vertebra; indeed, they are connected solely by this medium, having no articulatory surface in contact.

The *use* of this ligament is to prevent the rib from being thrust forcibly forwards from the transverse processes of the vertebræ.

Connexion of the Neck of the Ribs with the Articular and Transverse Processes.

The *external ligament of the neck of the rib* arises from the external surface of the inferior articular process of the vertebra above, and from the root of the transverse process. Between these two origins is a space for the passage of some posterior nerves from the intercostals; it then passes downwards, to be inserted into the upper part of the neck of the rib below. It prevents the neck of the rib from being elevated by the action of the intercostal muscles, but allows the head to turn in its capsule, so as to admit of the elevation of the body of the rib in inspiration.

The *internal ligament of the neck of the rib* arises from the anterior surface of the transverse process of the next superior vertebra, and passes downwards to be inserted into the fore part of the neck of the rib immediately below; it is attached, therefore, in a very similar manner to that of the external ligament of the neck of the rib, excepting that it is situated anteriorly, and its fibres pass somewhat more inwards, so as to decussate with those of the external ligament.

Articulation of the Body of the Rib to its Cartilage.

There are some anterior and posterior ligamentous fibres, which pass from the bodies of all the ribs to their respective cartilages, and connect them firmly together. The cartilages of the seven superior ribs pass forwards, to be attached to the sternum, with which they are connected by an anterior and posterior ligament, and synovial membrane.

The *anterior ligament* is fixed to the extremity of the cartilage; it then passes, with its fibres diverging, to be fixed to the anterior part of the sternum, upon which it spreads itself, and interlaces with those of the opposite side, and with the periosteum, as well as with the anterior ligament of the cartilage of the rib above and below it, so as to form a complete ligamentous covering to the sternum. This decussation of the fibres is more particularly obvious at the union of the sixth and seventh cartilaginous articulations with the sternum, than at any other part.

The *posterior ligament* is not so thick as the anterior, but is attached, like it, to the cartilages of the ribs, and to the sternum; while, on its posterior surface, it diverges and interlaces with the ligaments above and below, and with the periosteum, forming a complete posterior covering to the sternum.

The *synovial membrane* which covers the articular surface of the cartilage of the rib and of the sternum, is extremely small; and were it not for the occasional occurrence of an inordinate secretion of synovia, the result of inflammation, its existence might almost be doubted. The seventh rib being attached to the cartilago-ensiformis, its ligament is sometimes called the *ligamentum ensiforme*.

Articulation of the False Ribs.

These bones are all connected together by their cartilages excepting the last, which is only attached by muscle. Their union appears to be produced by anterior and posterior ligamentous fibres, similar to those which conneet the true ribs to the sternum, but they are not so strong.

Ligamentum arcuatum arises from the apiees of the transverse proeesses of the two upper lumbar vertebræ, and passes upwards and outwards to be attached to the acute edge of the last rib throughout its whole extent.

Articulation of the Bones of the Sternum.

Besides the ligaments whieh have been deseribed as passing from the eartilages of the ribs to the sternum, there are proper ligaments conneeting the three bones of the sternum, whieh prineipally pass in a longitudinal direction upon its anterior and posterior surfaees, and eover those ligaments whieh attaeh the eartilages of the ribs to the sternum. They may be termed the *proper, anterior,* and *posterior ligaments of the sternum.*

Practical Remarks.

From the numerous ligaments which connect the ribs to the vertebræ, and the improbability that sufficient force should ever be applied to one rib to produce dislocation, it is an accident that seldom occurs. Should it happen, however, that the head of a rib were detached from the vertebræ by any violence, the same symptoms would present themselves as in cases of fracture, and would require the same mode of treatment.

For my own part, I do not believe in the possibility of dislocation of the rib from the vertebræ, unless there has been some prior disease, which has partly destroyed its ligamentous connexions; on the contrary, I am disposed to conclude, that a rib sustaining such a degree of violence as might be supposed capable of dislocating it, would be invariably fractured at its neck. Such I find to be the case in experiments upon the dead body; for though the rib be subjected to the application of force, by means of an instrument best calculated to detach its head from the articulation, yet it is always broken. The cartilages are sometimes separated from the bodies of the ribs, and from the sternum; but this is more frequently the result of distortion of the spine, and consequent gradual displacement, than of any sudden violence.

Articulations of the Superior Extremity.

The shoulder is united by means of the clavicle with the sternum, through the medium of an interarticular cartilage, but the scapula is only connected with the trunk by muscle; and the sterno-clavicular articulation forms the fulcrum for the whole of the upper extremity to move upon the trunk.

Articulation of the Clavicle to the Sternum.

Class *Diarthrosis.*—Subdivision *Arthrodia.*

The sternal extremity of the clavicle is concave, and is placed rather above the articular surface of the sternum; these two surfaces are covered by cartilage. This articulation is constituted by four ligaments; an *anterior*, a *posterior*, an *interclavicular*, and a *costo clavicular*, or rhomboid; and by an *interarticular cartilage.*

The *anterior ligament* is composed of strong fibres, which run in parallel lines from the upper extremity of the clavicle to the anterior face of the first bone of the sternum: there its fibres diverge and mix with the ligaments connecting the first rib, and assist in forming the anterior ligamentous sheath of the sternum. Its posterior face is united firmly to the interarticular cartilage, and to the synovial membrane; its anterior corresponds to the origin of the sterno-cleido mastoideus muscle, and the integuments.

The *posterior ligament* is neither so large nor so strong as the anterior; it is united above to the posterior part of the internal surface of the clavicle, and below to the superior and posterior surface of the sternum, being firmly attached to the edge of the articular surface. The anterior portion of this ligament is in contact with the interarticular cartilage and the synovial membrane; the posterior covers and gives partly origin to the sterno-hyoideus and thyroideus muscles.

Interclavicular ligament. — This ligament is strong, and is composed of parallel fibres which run transversely from the head of one clavicle to the head of the other, above the concave semilunar edge of the sternum. It is sometimes composed of two fasciculi, an upper and a lower, but usually only of one. It is connected on the heads of the clavicles with the sterno-clavicular articulations ; and from its lower edge, as it passes above the upper part of the sternum, it is attached to its periosteum by cellular membrane.

The *use* of this ligament is not only to connect the clavicles firmly with each other, but also to strengthen their articulation with the sternum. It also assists in protecting the trachea, as it passes through the upper opening of the chest.

The *rhomboid ligament* is connected firmly with the inferior surface of the clavicle, and with a small tubercle close to its sternal extremity. It is strong and broad, and passes obliquely downwards and forwards to be inserted into the anterior part of the cartilage of the first rib, close to its junction with the sternum, and mixes with the ligament which connects them.

The *use* of this ligament is principally to fix the clavicle for the action of the sterno cleido mastoideus, and to give attachment to the subclavius muscle.

Interarticular cartilage.—This cartilage is very nearly circular, having a smooth surface above for its attachment to the clavicle, and one below for the sternum. It is thick and rough at its circumference, and comparatively thin in its centre. It adjusts itself to the articular surfaces of both the clavicle and sternum, extending as far on the latter bone as the attachment of the cartilage of the first rib, with which it is firmly connected. This cartilage is in the form of a wedge with its base turned upwards to the clavicle, and its apex descending obliquely to be connected with the first rib. In structure it resembles the interarticular cartilage of the lower jaw; its fibres being more apparent at the circumference than at the centre.

Synovial membrane.—This membrane is separated, as in the instance of every joint where there is an interarticular cartilage, into two synovial cavities; the upper one belonging to the articular surface of the clavicle, and the superior face of the interarticular cartilage; the lower one being between the sternum and the cartilage. They are reflected over the internal surfaces of the anterior and posterior sterno-clavicular ligaments. They secrete but an inconsiderable quantity of synovia, and sometimes the two cavities are united by an opening through the cartilage.

The upper synovial or clavicular capsule admits of motion upwards and downwards, while the lower or sternal capsule admits of backward and forward motion; and therefore we find in this, as in all other joints where there is an interarticular cartilage, that not only strength is added to the articulation, but that also its motions are rendered at least more varied, if not more extensive.

Articulation of the Clavicle with the Scapula.

This articulation is strengthened by the following ligaments, which may be divided into those which attach the clavicle to the acromion, and those which connect it with the coracoid process of the scapula. This latter junction is produced by ligament only, there being no bony continuity; while, in the former, the surfaces of bone are in juxtaposition, presenting superior and inferior surfaces, which give attachment to corresponding ligaments.

Articulation of the Clavicle with the Acromion.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

This articulation is strengthened by a superior and an inferior ligament, and is also furnished with a synovial capsule.

The *superior ligament* is composed of very strong fasciculi, which pass from the upper surface of the clavicle to the extremity of the acromion, and expose a surface for the tendinous insertion of the trapezius, and for the origin of the deltoid muscles, from which they are sufficiently distinct.

Inferior ligament.—This ligament, anteriorly, is in contact with the preceding; it then passes on the under surfaces of the clavicle and acromion, but does not extend so far backwards as to be connected with the posterior edge of the superior ligament; its inferior surface is in contact with the infra spinatus muscle, while its superior surface is connected with the synovial membrane of this articulation. It is so loose as to allow of some degree of motion independently of the scapula.

Synovial membrane covers the articular surfaces of both bones, but secretes very little synovia; it is sometimes divided into two cavities by an interarticular cartilage; this, however, is but of rare occurrence.

Junction between the Clavicle and Coracoid Process of the Scapula; or, Coraco Clavicular Union.

This union is formed by two ligaments, which connect the clavicle with the coracoid process. They arise by a single origin from the coracoid process, but separate into two portions to be inserted into the clavicle, which admits of their being described as two distinct ligaments—the *conoid* and the *trapezoid.*

The *conoid* is the posterior and internal of the two; it is of a conical form, with its base upwards, which is attached to the tubercle at the under part of the clavicle, its apex being connected with the coracoid process.

The *trapezoid* is anterior and external; it is broader than the conoid ligament, but not so strong; it extends from the middle of the convexity of the coracoid process, passes upwards and outwards, and is attached to the under surface of the scapular extremity of the clavicle, close to the connexion of this bone with the acromion. The connexion of these ligaments is strong; but, at the same time, they are sufficiently loose to admit of the scapula performing several of its motions without the clavicle, which may on this account remain stationary: they also serve, under very violent exercise, or in case of a blow, to prevent an immoderate depression of the scapula; for their strength is such as to resist violence, even to that degree which causes the fracture of the clavicle.

Ligaments proper to the Scapula.

There are two ligaments proper to the scapula: the *anterior*, or *acromio coracoid;* and the *posterior*, or *coracoid.*

The *anterior*, or *acromio coracoid ligament*, is triangular; it arises by its base from the outer side of the coracoid process, and is inserted by its apex into the inner side of the acromion. It is attached to the whole length of the external edge of the coracoid process, from which it sometimes passes in two fasciculi to the posterior edge of the acromion; but the space between the two is filled up by condensed cellular membrane. The anterior edge of this ligament gives off a strong fascia, which is attached to the under part of the deltoid muscle, and to the tendons of the supra and infra spinati. Its superior surface is covered by the clavicle and deltoid muscle; the inferior surface covers the supra spinatus. This ligament, passing from the acromion to the coracoid process, forms an arch over the head of the os humeri, which is usually said to assist in preventing dislocation of the os humeri upwards. This dislocation, however, is rendered impossible by the proximity of the acromion and coracoid processes, unless one or other of these processes be fractured; so that this ligament seems rather useful in extending the surface for the origin of muscle, than in preventing dislocation.

The *posterior*, or *coracoid ligament*, arises from the superior costa of the scapula, passes over the semilunar notch, which it forms into a foramen, and is attached to the root of the coracoid process: it is broader posteriorly than anteriorly.

It gives origin in part to the omo hyoideus muscle, covers the supra scapula nerve, which passes through the foramen, while the supra scapula artery takes its course above the ligament, and is consequently separated from the nerve by it: both the nerve and the artery, in passing to their destination, are situated in front of the origin of the omo hyoideus muscle.

Motions of the Clavicle.

I am now to describe the numerous and different motions of which the clavicle is capable, and from which it might *a priori* be supposed, that this bone would be very frequently liable to dislocation; in consequence, however, of the many strong ligaments which connect it at its sternal and scapular extremities, its luxation happens less frequently in proportion to its motions, than that of any other bone in the body.

The motions of the clavicle are dependant upon those of the scapula, which is capable of being moved upwards, downwards, forwards, and backwards; and from the combination of all these movements, it likewise admits of circumduction.

Although the scapular extremity of the clavicle receives the first impulse from muscular power, still it is at the sternal extremity that the ligaments sustain the greatest change under these various motions.

First, upwards.—When the shoulder is raised by the elevation of the scapula, the sternal extremity of the clavicle is thrust deeply into its articular cavity, and thus its interarticular cartilage is brought nearer to the surfaces of the clavicle and sternum; the rhomboid or costo-clavicular ligament being put upon the stretch, prevents luxation and further motion; while the interclavicular, anterior, and posterior ligaments, are relaxed.

Secondly, downwards.—In this motion, the ligaments are precisely in an opposite state to the preceding.

Thirdly, forwards.—It is in this motion that the clavicle is most liable to be luxated backwards at its sternal extremity; but in consequence of the strength of the posterior and inter-clavicular ligaments, which are put upon the stretch, this accident is prevented; the anterior ligament is necessarily relaxed, but the rhomboid or costo-clavicular ligament remains in its natural state.

Fourthly, backwards.—In this motion the scapular extremity of the clavicle is drawn backwards, while its sternal extremity is thrust forward, and stretches the anterior sterno-clavicular ligament. If at this moment the shoulder were violently thrust still farther backward, the sternal extremity of the clavicle might be dislocated forward; but the rarity of this accident is dependant upon the strength of the inter-clavicular and posterior ligaments, which are put upon the stretch.

Lastly.—With respect to circumduction, it is a quick succession of all these motions; during which, the ligaments adapt themselves with rapidity to their alternate states of relaxation and extension.

Practical Remarks.

The clavicle may either be dislocated from the sternum, or from the acromion process of the scapula; but fracture of this bone much more frequently happens than displacement of its articulatory surfaces.

The dislocation of its sternal extremity may occur in three directions; either forwards, backwards, or upwards: but dislocation downwards cannot happen, in consequence of the attachment of the interarticular cartilage to the first rib.

It is the dislocation *forwards* which is most frequent, and generally occurs from the application of force upon the shoulder, when the arm is carried to its fullest extent backwards,—a direction in which it is most capable of being moved: at this time, the sternal extremity of the clavicle is thrust forcibly against the anterior ligament, which may give way, and the articular surface of the clavicle pass on the upper and fore part of the sternum. It is not, however, the strength of the anterior ligament only, which prevents the frequent occurrence of this accident, but also the attachment of the m. sterno cleido mastoideus. The diagnosis in this accident is very easy, in consequence of the superficial situation of the bone affected. The extremity of the clavicle is readily felt and seen in its new situation; the shoulder seems to fall upon the chest, and the patient loses the power of raising his arm, from the loss of its fulcrum.

When the dislocation occurs *backwards*, it is produced by the scapula being thrust violently forwards, by which force the sternal extremity of the clavicle is thrown behind the upper part of the sternum. This accident is of a much more serious nature than the last described, as all the sterno-clavicular ligaments, and even the costo-clavicular, must be torn through to admit of this displacement; it is therefore, as may be supposed, of but rare occurrence. This accident may produce most serious symptoms, from the bone pressing upon the trachea, œsophagus, and vessels of the neck, as has been described by Petit and Sir Astley Cooper, rendering it necessary, in some cases, to saw off the extremity of the bone,—an operation which has been performed by Mr. Davy, a surgeon in Suffolk.

The dislocation *upwards* is effected by a sudden and violent depression of the shoulder, which allows the extremity of the clavicle to pass above the upper bone of the sternum, and to approach the clavicle of the opposite side, necessarily diminishing the space between them, and relaxing the interclavicular ligament. The diagnostic marks of these displacements are sufficiently conspicuous, from the circumstances alluded to in the dislocation forwards.

The mode of reduction of a dislocated clavicle is similar to the means used in fracture of that bone: by placing a pad in the axilla, and by making a lever of the humerus, the shoulder is carried outwards; and the scapula should be fixed with a direction either backwards, forwards, or upwards, depending on the position of the dislocated clavicle.

Dislocation of the scapular extremity of the clavicle is less frequent than that of the sternal extremity, but it does occur in two directions, so that the clavicle may either be thrown *above* or *below* the acromion process of the scapula. The displacement upwards is the most frequent, in consequence probably of the form of the articulatory surfaces; it is produced by a fall on the point of the shoulder, which is driven downwards, so that the clavicle, losing its attachment to it, slides on the upper surface of the acromion. In this dislocation the superior and inferior acromio clavicular, as well as the coraco clavicular ligaments, are torn through. The nature of the accident is easily understood, not only from the superficial situation of the parts, but also from the loss of motion of the extremity; for the patient has great intolerance to any motion of the arm, as it calls into action the deltoid and trapezius muscles, which move the dislocated bones, and consequently produce great pain.

This dislocation is reduced in the same manner as described in luxations of the sternal extremity, but there is more difficulty after the reduction is completed, in keeping the bone in its situation; therefore, particular attention should be paid to the application of the bandages; for should the bone remain unreduced, the motions of the whole extremity are impeded, and the patient remains for life more or less disabled.

Articulation of the Humerus with the Scapula.

CLASS *Diarthrosis.*—SUBDIVISION *Enarthrodia.*

The bones which enter into the composition of the shoulder-joint are the scapula and the humerus; the head of the latter being received into the glenoid cavity of the former, and there retained in its situation by ligaments. This articulation is usually classed as arthrodial; but the depth of the glenoid cavity when furnished with its ligament, the form of the head of the humerus, and the arrangement of all its ligaments, render the joint more similar to a ball and socket than a planiform articulation. On examining the glenoid cavity of the scapula in the recent state, we find it rendered deeper by a fibro-cartilaginous substance, which surrounds its edge, and is attached to the tendon of the long head of the biceps muscle; this is called the *glenoid ligament;* it assists in retaining the head of the humerus in its situation, and also gives extent of surface for the attachment of the synovial membrane.

Before I enter upon a description of the ligaments, I would direct the attention of the student to the peculiar construction of this joint, which excels all others of the body by its extent and variety of motion. This superiority arises in a considerable degree from the action of the numerous muscles inserted into the scapula, which is thus endowed with a mobility peculiar to itself. It is also owing to the form of the articulatory surfaces of that bone and the os humeri, which are most effectually adapted to the above purposes; the ligaments also are sufficiently loose to allow full play to the bones while under the influence of the muscles; which combined circumstances render this joint so particularly liable to dislocation. Thus we find that anatomy, physiology, and even pathology, all tend to illustrate the different functions of this joint.

Capsular ligament.—This ligament envelops the joint. It arises from the neck of the scapula, and adheres to the glenoid ligament, over which it passes; then expands itself, to surround the head of the os humeri; and contracts again, as it extends downwards, to be inserted into the neck of the humerus; reaching as far as the tubercles of this bone, where it is inseparably connected with the tendinous insertions of the teres minor, spinati and subscapularis muscles. This capsule, where it extends from the greater to the smaller tubercle of the humerus, leaves a foramen for the passage of the tendon of the long head of the biceps muscle.

The capsular ligament is not of a uniform thickness, being thinnest on its outer and hinder part; but here it is strengthened by the tendons of the teres minor and infra spinatus muscles. On the inner side towards the axilla, where there is no tendinous expansion to give it support, it is found sufficiently strong and unyielding to prevent the displacement of the head of the humerus in that direction by any ordinary force. Besides the support which this ligament receives from the tendons of muscles, it derives additional strength from strong fasciæ, which extend from the acromion and coracoid processes of the scapula: it is especially fortified by a fascia from the anterior part of the triangular or coraco acromial ligament, which is found immediately underneath the belly of the deltoid muscle; and further by the *accessory ligament,* which is situated on the fore and inner side of the articulation, proceeding from the coracoid process of the scapula to the greater tuberosity of the humerus, connecting itself with the tendon of the infra spinatus muscle. We find that the capsular ligament of this joint is more lax than is necessary for the mere junction of the two bones which it connects, in order to allow the free and various motions of which the shoulder-joint (constituted, as its form shews, rather for mobility than strength), is so capable.

This ligament, then, appears to be of as much service in giving attachment to the synovial membrane, which completely lines it, as in preventing the dislocation of the head of the os humeri. Of the four muscles which are inserted into the capsular ligament, the tendon of the subscapularis is most completely blended with it, so that it is not practicable to separate them without laceration. This tendon seems even to pierce the capsule, in order to gain its insertion into the smaller tubercle of the humerus.

The *glenoid ligament* is composed of fibro-cartilaginous tissue, and forms a rim around the articulatory surface of the scapula, which it renders deeper. It derives its fibrous texture from the tendon of the long head of the biceps, which is not only attached to the upper edge of the glenoid cavity, but bifurcates and passes down on either side, to form in part the glenoid ligament. Its cartilaginous texture is produced by a continuation of the permanent or articular cartilage of the scapula. This ligament is triangular in form; its base being attached to the circumference of the glenoid cavity, and its apex forms a thin free edge.

Synovial membrane.—This membrane lines the glenoid cavity, passes over the glenoid ligament, to which it is attached upon its internal and external surfaces; extends as far back upon the neck of the scapula as the origin of the capsular ligament, which it completely lines; then passes partly under the tendinous insertions of the spinati muscles, covers the cartilaginous head of the os humeri, prolongs itself into the bicipital groove, forming a *cul de sac,* so as to prevent the escape of synovia, by enveloping the tendon of the biceps; then extends itself, by passing inwards, to give a lining to the insertion of the subscapularis muscle. Thus it retains the characteristic of all synovial membranes, forming a complete cavity without an external opening.

The *use* of this membrane is to secrete synovia for lubricating the joint; and this secretion being always proportioned to the mobility of the articulation, the quantity in this instance is very considerable.

Motions of the Humerus on the Scapula.

These motions are not only various in direction, but also very extensive, in consequence of the independent mobility of the scapula.

The humerus is capable of being *raised* or *depressed*, carried *backwards* or *forwards, inwards* or *outwards;* of being *rotated;* and a combination of all these directions, which is termed *circumduction.* Hence it is obvious that numerous muscles serve to perform these different motions, and which, it must be remembered, add much to the strength of the articulation, and prevent, therefore, the frequent occurrence of displacement.

When the humerus is raised to its fullest extent, the head of the bone slides from the upper to the lower part of the glenoid cavity, and presses against the inferior part of the capsular ligament, while its raised shaft is opposed to the acromion process of the scapula: it is in this position that dislocation is most likely to occur; for if any force should propel the humerus backwards, the head of the bone is driven through the lower part of the capsular ligament.

In depression of the shoulder, the head of the humerus is drawn from the glenoid cavity, and the capsular ligament and tendon of the biceps muscle are put upon the stretch, which restrain the depression beyond a certain extent, unless the force be sufficient to tear these structures. When the arm is directed behind, the head of the humerus is pressed forward against the capsular ligament, but which is at this part so strengthened by the tendons of the spinati subscapularis muscles, and the deltoid, that the extent of motion, in this direction, is less than when the arm is carried either forwards or upwards, although this movement is much increased by the mobility of the scapula.

In the forward direction of the arm, the articular surface of the humerus remains in contact with the glenoid cavity of the scapula, unless, at the same time, the arm be directed upwards, when the head of the humerus becomes depressed towards the inferior part of the capsular ligament, as before described.

In the rotatory motions, the head of the humerus turns upon its own axis in the glenoid cavity, and is directed either from behind to before, or from before backwards, as the rotation may be either inwards or outwards.

In circumduction, the head of the humerus successively occupies the various situations which have been described as concomitant with the other motions of the articulation; and the whole of the upper extremity, during the evolution, forms a cone, the base of which is at the hand, and the apex at the shoulder-joint.

Practical Remarks.

In dislocations of the os humeri, all the muscles which arise from the scapula, and are inserted into that bone, must be more or less affected in its displacement; and it may be luxated in four directions: three, in which the head of the bone is completely thrown from the glenoid cavity, and one, where it rests upon its edge, to the outer side of the coracoid process of the scapula. I shall therefore describe the state of the capsular ligament, and the muscles of the shoulder-joint, under each particular form of displacement.

First, downwards and inwards into the axilla, which is the most common direction of displacement, in consequence of the capsular ligament being thinnest at that point, and therefore more liable to be lacerated. In this accident, all those muscles which arise from the upper part of the scapula, and are inserted into the os humeri, must be more or less put upon the stretch, as the points of attachment of these muscles are rendered more distant from one another. It is clear, therefore, that the two spinati, the subscapularis, the coraco brachialis and the teres minor, must be extended; more particularly the subscapularis, not merely from the separation of its two points of attachment, but also from the pressure of the head of the os humeri, which is frequently so great as to cause the laceration of that muscle. The elbow, in this accident, being removed to a considerable distance from the side, the teres major, with the posterior fibres of the deltoid muscle, are relaxed; while the anterior fibres of the latter muscle are extended. The pectoralis major, and the latissimus dorsi, are but slightly affected; but are still to be kept in view, with regard to the reduction of the bone, as they would otherwise form a very considerable opposing force.

In this accident, the capsular ligament is torn through on the inner side of the glenoid cavity, near to the insertion of the subscapularis, so as to allow the head of the humerus to pass through it into the axilla.

The diagnostic marks of this accident are sufficiently obvious, to prevent any mistake as to its nature. The dislocated arm is longer than the other: and if you examine the direction of the upper arm, you find, that instead of the shaft of the bone leading you upwards to the glenoid cavity of the scapula, it is directed deeply into the axilla; the elbow is separated from the side, the roundness of the shoulder is lost, and the acromion projects itself, and immediately under it an empty space may be felt, which is, in fact, the glenoid cavity: the head of the humerus may be found in the axilla, and the patient is unable to bring his hand to his head.

Secondly, dislocation forwards under the pectoral muscle.—The spinati and subscapularis muscles are put upon the stretch, much to the same extent as in the last dislocation; the teretes are somewhat extended, the pectoralis major is relaxed, while the latissimus dorsi is put upon the stretch. The capsular ligament is torn through, as in the last described accident..

In this accident, the head of the humerus is directed towards the centre of the clavicle, and may be felt behind the pectoral muscle, opposite to the third rib, resting upon the serratus magnus muscle: the elbow is separated from the side, as in the preceding case, but is carried rather further backwards. The patient has the power of moving the arm slightly backwards; but any attempt to bring the arm forward produces considerable pain.

Thirdly, dislocation backwards, or upon the dorsum scapulæ.—In this accident, the subscapularis must be necessarily torn through. The spinati, with the teres major, are relaxed, while the teres minor remains much in its natural state as to its degree of extension, although its direction be somewhat changed. The deltoid and coraco brachialis muscles are relaxed, while the pectoralis major and latissimus dorsi are in a state of extension. The capsular ligament is torn through.

When the dislocation is backwards and outwards, the head of the bone may be felt immediately below the spine of the scapula; the elbow is carried from the side, but with a slight direction forwards: the arm is somewhat lengthened.

Fourthly, partial dislocation forwards, where the head of the bone rests on the edge of the glenoid cavity.—Here the subscapularis is found but little altered from its natural state. The spinati muscles are slightly extended. The anterior fibres of the deltoid are relaxed, while its posterior fibres are stretched. The teretes are extended, and the pectoralis major is relaxed, excepting a few of its inferior fibres, while the latissimus dorsi is put upon the stretch. It is not indispensable to the occurrence of this accident that the capsular ligament should be torn through.

When speaking of the fractures of the os humeri, I mentioned those accidents which have symptoms in any way analogous with dislocation; but, as a general rule, it may be remembered, that in fracture, the injured bone is always capable of being moved, even in directions not natural to the bone; while in dislocations it is fixed, and not capable of motion, unless a force be used sufficient to return the luxated bone into its natural situation.

With respect to the modes of reduction, mere mechanical rules will be of little avail, unless the surgeon possesses sufficient experience to warrant him in exercising his own discretion in the means to be applied for the purpose, which must vary according to circumstances in every particular case. The following, however, may be considered as general points to be attended to: the means of fixing the socket for the reception of the displaced head of the bone; the relaxation of the muscles, the unnatural tension of which constitutes the principal opposing force; the direction in which the extension is to be made; and the best mechanical mode of applying the extending power.

Articulation of the Humerus with the Radius and Ulna.

Class *Diarthrosis.*—Subdivision *Ginglimus.*

The elbow-joint is composed of the condyles of the humerus above, and of the heads of the radius and ulna below; the rounded extremities of the former being received into corresponding cavities in the two latter, the surfaces of which are completely covered with cartilage. This union forms a complete hinge-joint; but the radius also enjoys rotatory motion, which produces pronation and supination of the hand: this is effected by the head of the radius receiving but a small rounded portion of the external condyle of the humerus above, while the inner half of the circumference of its head is received into the lesser sigmoid cavity of the ulna, both these portions being covered with cartilage. This mode of articulation allows the radius to turn upon its own axis.

Four ligaments concur in the formation of the elbow-joint: an *anterior*, a *posterior*, an *external* and an *internal lateral ligament;* all of which are lined by *synovial membrane.*

The *anterior ligament* arises from the lower part of the humerus, between the two condyles immediately above the cavity which receives the coronoid process of the ulna in flexion; it also reaches laterally as far as the edges of the condyles, over which it passes downwards to be inserted into the coronary ligament of the radius and root of the coronoid process of the ulna: its fibres pass in different directions; those from the internal condyles, with considerable obliquity, to be attached to the coronary ligament of the radius, while the middle and external fibres pass vertically downwards.

The *posterior ligament* arises from the upper part of the cavity in the humerus, which receives the olecranon of the ulna in extension; it passes laterally on the sides of the condyles, where it meets with the anterior ligament, and also with the upper edges of the internal and external lateral ligaments; it is loosely connected with the olecranon, and is inserted into the lower and posterior part of the os humeri, between the two condyles. This ligament can only be entirely exposed when the fore arm is flexed upon the upper. Its posterior surface is covered by the tendon of the triceps, while its anterior is in contact with the synovial membrane, which lines both this and the anterior ligament.

External lateral ligament.—This ligament is so intimately connected with the tendons of those muscles which arise from the external condyle of the os humeri, as to be with difficulty separated, and does indeed seem to have a common origin with the supinator radii brevis; it is of a triangular shape, its apex being situated above and its base below; it arises from the lower part of the external condyle, becomes broader as it descends, passes over the articulation, then spreads itself so as to surround the head of the radius, and is inserted into the anterior and posterior edges of the smaller sigmoid cavity of the ulna in common with the coronary ligament, which it covers. Thus it is clear that the rotatory motion of the radius is not confined by this ligament, as it is inserted only into the ulna and coronary ligament, and is entirely unconnected with the radius itself.

Internal lateral ligament.—This ligament is of the same shape as the preceding, being triangular; but is more distinctly marked by the direction of its fibres, which pass anteriorly and posteriorly. It arises from the internal condyle; the anterior fibres, passing from it to the coronoid process of the ulna, are eovered by the flexors of the wrist and fingers, and are in eontact with the synovial membrane; its posterior fibres have the same origin, diverge from the former, and pass baekwards to be inserted into the inner side of the oleeranon; they also give attachment to the synovial membrane, and proteetion to the ulnar nerve. The insertions of this ligament are eonnected by some ligamentous fibres which are attaehed to the oleeranon and eoronoid proeess, and, by some anatomists, have been deseribed as a separate ligament.

Synovial membrane.—To obtain an aeeurate knowledge of this membrane, the tendinous expansion of the museles, with the ligaments eonnecting the joint, and the subjaeent fat, must be removed; we shall then find that it takes its origin from the anterior eoneave surfaee of the oleeranon, passes down to line the whole of the great sigmoid eavity of the ulna, prolongs itself between the radius and ulna, covering the lesser sigmoid eavity, reaehes as far as the neek of the radius, where it beeomes refleeted, forming a *cul de sac*, and here lines the inner surfaees of the eoronary ligament; it then extends itself upon the posterior surfaee of the anterior ligament of the elbow-joint, passes over the two eondyles of the os humeri, eovers the anterior surface of the posterior ligament, and terminates at the point from which we began the deseription.

Motions of the Elbow-Joint.

Flexion and extension are the only motions of which the elbow-joint is capable. During flexion, the radius and the ulna slide from behind to before on the condyles of the humerus, so as to allow, in the most perfect state of flexion, the fore arm to form a very acute angle with the humerus: indeed, it becomes almost parallel with it, which is admitted by the coronoid process of the ulna dipping into the pit on the fore part of the humerus. The anterior surface of the external condyle is covered with articular cartilage, that the radius may enjoy the same extent of flexion as the ulna.

During extension, the radius and the ulna move from before backwards on the condyles of the humerus, and the full extent of this motion is completed, when the arm is brought to nearly a straight line; for extension cannot be carried beyond this, in consequence of the olecranon striking against the back part of the humerus. In the performance of this motion, the radius is separated from the external condyle of the humerus; so that in the perfect state of extension these two bones are not in contact, but the radius is pressed firmly into the lesser sigmoid cavity of the ulna; and its rotatory motion in this state is rendered much less perfect, in consequence of its having lost its support from the humerus.

Practical Remarks.

The radius and the ulna may be dislocated from the humerus either *backwards* or *laterally:* forwards they cannot be thrown without fracture of the olecranon; so that luxation in that direction is only to be considered as a secondary accident.

In the dislocation of both bones *backwards*, the radius and ulna are thrown upward behind the condyles of the humerus, and the coronoid process of the ulna occupies the fossa situated at the posterior part of the humerus, while the radius rests above the external condyle. The capsular ligament is torn through anteriorly; the internal lateral ligament is relaxed, and the external lateral is liable to have its anterior fibres lacerated. The coronary ligament suffers no change but in position, being drawn with the dislocated bones upwards and backwards. The biceps is considerably extended, but not to the same degree as the brachialis internus, in consequence of the more elevated situation of the coronoid process of the ulna, into which this muscle is inserted. The triceps muscle is relaxed, from the approximation of its points of attachment; and the anconeus, although it must necessarily be relaxed, is in danger of having some of its fibres lacerated by the forcible projection of the head of the radius above the external condyle, from which this muscle has origin. All muscles which arise from the condyles of the os humeri are necessarily relaxed, excepting the supinator radii brevis, which has some of its fibres torn through. The fore arm, in this accident, maintains a semiflexed position; and no force less than that which is capable of reducing the dislocated bones will produce extension. The best diagnostic mark of this accident is the change of position of the olecranon, which is found thrown up above the external condyle; instead of being, as is its natural position, upon a level with it.

The dislocation of both bones *laterally*, can take place either to the inner or outer side; but in consequence of the great extent and irregularity of the articular surfaces, it is never complete: this luxation is of rare occurrence in comparison with the last mentioned accident. The state of the muscles, and of the capsular ligament, are under the same circumstances as in the dislocation backwards, with this unimportant difference: that the muscular fibres have an obliquity either outwards or inwards, depending on the direction of the dislocated bones.

The dislocations of the head of the radius, which are generally enumerated amongst the accidents of the elbow-joint, may be more properly considered as injuries incident to the superior radio ulnar articulation.

Radio Ulnar Articulations.

The radius and the ulna are connected along their whole course by ligaments; which, according to their relative situations, may be divided into those of the *superior, middle* and *inferior articulations.*

The Superior Radio Ulnar Articulation.

CLASS *Diarthrosis.*—SUBDIVISION *Trochoides.*

The upper extremity of the ulna is furnished with a depression, which is named the smaller sigmoid cavity, for the purpose of receiving the head of the radius. Both the cartilage and synovial membrane which enter into the composition of this joint, are continuous with that of the elbow. This articulation forms a lateral hinge, admitting of the supination and pronation of the hand, but is not affected with the motion of flexion and extension of the fore arm. There is but one ligament connecting this joint, named

The *coronary ligament*, which is composed of strong and thick fasciculi, which arise from the posterior edge of the lesser sigmoid cavity of the ulna; it then passes around the neck of the radius, and is inserted into the anterior edge of the same cavity, thus forming three fourths of a circle, from which disposition it gains its name. This ligament passes in such close contact with the radius as to prevent any separation, but is not adherent to it, and therefore allows of the free rotatory motion of that bone: it is fibrous in its texture; the fibres pass in a circular direction, and are more obvious at its extremities than in its centre. The external surface of this ligament is covered by the muscles arising from the outer condyle of the humerus, and by the external lateral ligament: its internal surface is lined by the synovial membrane; which, as I before said, is continued from the elbow-joint. Its superior circumference is connected with most of the ligaments of this articulation, while its inferior circumference is free.

Middle Radio Ulnar Articulation.

This connexion of the radius and ulna hardly deserves the name of an articulation, as the bones are not found in actual apposition. There are two ligaments which serve to connect the radius and ulna nearly their whole length; they differ in their figure and in their use; the upper one is a mere chord, which extends transversely from one bone to the other, and assists in preventing their forcible separation; the other is a broad ligament, which fills up the space produced by the natural separation of the radius from the ulna; and not only connects these bones, but also gives origin to many muscles, and thus becomes included within the seventh class.

The *oblique ligament* is composed of thin fibrous fasciculi, which are rounded in their form, and originate on the outer side of the coronoid process of the ulna, just below the insertion of the brachialis internus muscle; it then takes an oblique direction downwards and outwards, passes across from one bone to the other, and is inserted into the tubercle of the radius, immediately below the insertion of the biceps; and as it crosses from its origin to its insertion, it forms an opening between it and the interosseous ligament, through which pass vessels and nerves. This ligament separates the superficial from the deep set of muscles of the fore arm, and is anterior to the interosseous ligament.

The *interosseous ligament* begins to arise immediately below the tubercle of the radius, and passes from the inner sharp edge of the radius to the outer edge of the ulna. It is not one uninterrupted extension of ligament, but consists of a great many flattened fasciculi, which are separated from each other, leaving openings for the transmission of vessels and nerves: it extends as far inferiorly as to the connexion of the radius with the ulna. Its two lateral edges are firmly connected with the periosteum of the two bones to which they are attached. Its anterior face above gives attachment to the deep flexor muscle of the fingers, and to the proper flexor of the thumb: its lower fourth is covered by the pronator quadratus muscle. On the posterior surface of this ligament may be seen some fibres, which pass from the ulna to the radius, and which, consequently, cross the usual direction of the fibrous texture of the interosseous ligament, thus tending very much to strengthen it. This ligament is covered posteriorly by the supinator radii brevis, and extensor muscles of the fingers and wrist. There has been already mentioned one opening above, which is between the interosseous and the oblique ligaments, and which allows the passage of the interosseal vessels; but below there is another, of an oval form, just above the pronator quadratus muscle, extending through the ligament itself, and giving exit to the anterior interosseous vessels.

The *use* of the interosseous ligament appears to be rather for the attachment of muscle than for the firm connection of the radius and ulna, which are so strongly bound together at each extremity as scarcely, in that respect, to need its support; it does, however, assist in preventing the radius from being dislocated from the ulna.

Inferior Radio Ulnar Articulation.

At the inferior extremity, the radius receives the ulna in a concave articular surface, which is covered with cartilage and synovial membrane, the two bones being retained in their situation by some anterior and posterior ligamentous fibres, which pass transversely from one bone to the other, and strengthen the synovial capsule. There is also an interarticular cartilage, extending from the inner edge of the radius, and insinuates itself between the ulna and the bones of the carpus, which assist to complete this articulation. This cartilage I shall now proceed to describe.

The *interarticular cartilage* is a production from the cartilaginous surface of the scaphoid cavity of the radius, proceeds from it obliquely inwards, and is placed transversely between the inferior extremity of the ulna and cuneiform bone; thus preventing the extremity of the ulna from coming in contact with the bones of the carpus, and dividing the synovial cavity of the wrist from that of the inferior radio ulnar articulation.

The external edge of this cartilage is connected with the lower and inner edge of the radius, while its internal edge is free, with relation to bone, being only attached to the styloid process of the ulna through the medium of the internal lateral ligament of the wrist-joint. Its superior surface is opposed to the inferior extremity of the ulna: its inferior surface is in the same plane with the scaphoidal cavity of the radius, and opposed to the cuneiform bone of the first range of the carpus. During the motions of pronation and supination of the hand, the interarticular cartilage is pressed against the styloid process of the ulna, and thus forms the fixed point for the motions of the radius.

Synovial membrane.—This membrane is situated between and reflected over the surfaces of the outer and lower extremity of the ulna, the superior surface of the interarticular cartilage, and the small articular cavity on the radius which receives the ulna. On a more accurate examination we may trace it, first covering the outer surface of the styloid process of the ulna, from thence it descends upon the superior surface of the interarticular cartilage, passes upon it outwards to the point where this cartilage is connected with the radius, then is continued upon the cavity of the radius which receives the ulna, passes over to that bone, forming a *cul de sac,* or sacciform ligament (as it is called), between the two, then descending along the articular surface of the ulna, and terminating at the place from whence I commenced the description; this synovial cavity being entirely separated from that between the radius and the bones of the carpus by the interarticular cartilage.

Motions of the Radio Ulnar Articulations.

These motions produce pronation and supination of the hand, which are effected by the radius turning inwards or outwards on the ulna, and carrying the hand along with it. In pronation, the head of the radius turns upon the ulna in a direction from without to within, rolling within the annular ligament; while its inferior extremity turns also from without to within upon the ulna; describing in this motion a considerable portion of a circle; so that the relative position of the two bones becomes somewhat altered, by the radius obliquely crossing the ulna:—in this motion the palm of the hand faces backwards. Supination is produced by reversing the former motion, by bringing the two bones again parallel, and by directing the palm of the hand forwards.

Practical Remarks.

The head of the radius may be dislocated from the lesser sigmoid cavity of the ulna, so as to be thrown upon its fore or back part, which accidents, as I have before mentioned, are usually described as incident to the elbow-joint, but more properly belong to the superior radio-ulnar articulation.

On examining the form of the articulatory surfaces of this joint, we should be led to suppose that the dislocation *forwards* happened more frequently than that *backwards;* but the reverse is found to be the case: for as these accidents occur from violent and inordinate force in the motions of pronation and supination; the former being so much more extensive than the latter, tends to throw the head of the radius behind the ulna; while the comparatively less extensive motion of supination, rarely produces a luxation forwards.

When the radius is dislocated *backwards*, the nature of the accident may be learnt by feeling on the outer side of the arm, an inch below the external condyle, when a depression is felt instead of the natural projection produced by the head of the bone, which is found placed on the back part of the olecranon. The hand is in this accident proned, and cannot be brought to its natural state. The mode of reduction is obvious from the position of the injured limb, viz., that the fixed position of pronation is to be overcome; which may be effected by semiflexing the fore arm, for the purpose of relaxing the biceps muscle; by producing a forcible motion of supination, and at the same time pushing the head of the radius forwards and inwards, towards the lesser sigmoid cavity of the ulna: the natural position of the two bones is thus usually readily restored; unless, indeed, the dislocation has been allowed to remain unreduced for a considerable time.

In the displacement *forwards*, which is an accident of very rare occurrence, the great distinction is the fixed, supined position of the arm; and the tumour formed by the head of the radius, being on the fore instead of the back part of the ulna, as in the last described injury. The means to be employed for the reduction are, to prone the hand, and to push the head of the radius backwards. The after-treatment of these accidents consists in applying compresses with rollers, so adjusted as to press particularly on the head of the radius, and to prevent the recurrence of displacement, which is so liable to happen, in consequence of the annular ligament being torn through; neither should any motion be allowed for some time, as the ligaments are slow in their reparative powers.

The ulna is also sometimes luxated from the inferior extremity of the radius; for although the radius moves upon the ulna at the inferior radio ulnar articulation, still it is to be considered as the extremity of the ulna, which escapes from the lesser scaphoid cavity of the radius, rather than a displacement of the radius itself. The inferior extremity of the ulna may be dislocated either forwards or backwards from the radius; the displacement backwards is most frequent, as it is produced by an excessive pronation of the hand—a motion much more frequently exerted than supination, which has a tendency to produce the dislocation forwards.

Radio Carpal Articulation; or, Wrist-Joint.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

This joint is produced by the junction of the hand and the fore arm. The convex surfaces of the os scaphoides and the lunare, are received into the cavity formed at the inferior extremity of the radius, while the cuneiform bone is opposed to the under surface of the interarticular cartilage, which cartilage has already been described as assisting in the formation of the inferior radio ulnar articulation; all of these surfaces are covered by a synovial membrane. This joint is further strengthened by the four following ligaments.

The *anterior ligament* is flat and delicate in its texture; it arises from the fore part of the inferior extremity of the radius, passes downwards and forwards to be inserted into the scaphoid, lunar, and cuneiform bones; it is covered by the tendons of the flexors of the fingers, and posteriorly it is lined by the synovial membrane.

The *posterior ligament* arises from the lower and back part of the radius, and passes to be inserted into the lunar and cuneiform bones; this ligament is not so strong as the anterior; it is covered by the extensor tendons of the fingers, and is opposed to the synovial membrane.

The *external lateral ligament* arises from the lower extremity, or apex, of the styloid process of the radius, descends to the bones of the carpus; is inserted into the outer side of the scaphoid bone, and from thence is continued to the trapezium: it is of a triangular form, the apex being attached to the radius, while the base is composed of diverging fibres, which pass before and behind, and are connected with the anterior and posterior ligaments, which have been just described.

The *internal lateral ligament* arises from the inner surface of the styloid process of the ulna, and passes downwards to be inserted into the cuneiform bone, from which it sends off a strip anteriorly to be connected with the os pisiforme. As this ligament passes from the ulna to the carpus it becomes attached to the interarticular cartilage, which divides the ligament into an upper and a lower half; the upper portion is covered by the synovial membrane of the inferior radio ulnar articulation, and the lower by the synovial membrane of the radio carpal articulation. Both these last described ligaments are very strong, and prevent the displacement of the bones, which might otherwise have been of frequent occurrence, from the extent of motion to which they are liable.

Synovial membrane.—This membrane covers the scaphoid cavity at the lower extremity of the radius, and the under surface of the interarticular cartilage; passes anteriorly from these points of attachment to the inner surface of the anterior ligament of the wrist-joint, and to the lower half of the internal lateral ligament; then passes upon the superior surfaces of the scaphoid, lunar and cuneiform bones, dipping in between each to line their connecting faces, and forming a synovial cavity between them; ascends upon the posterior ligament, passes sufficiently far outwards to give a lining to the external lateral ligament, and terminates at the point from whence this description began.

From these particulars it is clear that there are two joints at the wrist; the one is named the inferior radio ulnar articulation, which does not form a joint with the bones of the carpus, but allows the radius to roll upon the ulna, and perform the motions of pronation and supination of the hand, while the radio carpal articulation admits of the motions of flexion and extension, and forms a joint with the three outer bones of the first carpal row;—not that the cuneiform bone is in contact with the radius, but that it is still connected with it by the same synovial membrane which is common to the other two bones of the carpus.

Previous to describing the ligaments proper to the bones of the carpus, I shall give an account of such as tie down the tendons of those muscles serving for the motions of the hand and fingers, which are found on the dorsal and palmar regions of the wrist, commencing with the palmar region.

Ligamentum carpi annulare.—This ligament, which is extremely strong, passes anteriorly to the concave arch of the carpus, for the purpose of tying down the tendons of the flexor muscles of the fingers, and also assists in preventing displacement of the carpal bones under any violent application of force. It arises from the pisiform bone, and from the hook-like process of the unciform, passes transversely across the carpus, and is attached to the scaphoid and trapezium. Its posterior surface is in contact with the flexor tendons of the fingers, and the anterior is covered by the aponeurotic expansion of the palmaris longus, and by the muscular fibres of the palmaris brevis, by the ulna artery, and by the superficial volar branch from the radial. The ulna artery, however, as it runs over the ligament, is protected by a process of it which passes from the pisiform bone, or rather from the insertion of the flexor carpi ulnaris, outwards to the middle of the superior edge of the annular ligament, and thus forms a groove for its safe transmission.

Ligamentum carpi annulare dorsale.—This ligament is situated on the posterior part of the wrist; performing the same office, in tying down the extensor tendons of the hand and fingers, which the preceding ligament performs for the flexors. It arises from the styloid process of the radius, passes in an oblique direction from without to within, to be attached to the styloid process of the ulna; and in its passage along the posterior surface of these bones, it is connected with the edges of the grooves, which allow the passage of the extensor tendons, and thus forms sheaths for their protection and transmission. Its posterior surface is only covered by skin and cellular membrane; while, anteriorly, it is in contact with the tendons, and a membrane which secretes a fluid to lubricate them, and consequently prevents friction on their various motions. Its inferior edge sends off an aponeurotic expansion, which passes over the back of the hand, and assists in maintaining the extensor tendons in their passage to the fingers.

Motions of the Wrist-Joint.

The hand moves on the fore arm, so as to allow of flexion, extension, abduction, adduction, and slight circular motion. With respect to the motions of flexion and extension, this joint differs from all others, in allowing extension to the same extent as flexion; indeed, it is the direction in which the hand is most frequently employed. The slightest circular motion of the hand upon the radius, assists in the perfect performance of the movements of pronation and supination.

Articulation of the Bones of the Carpus with each other.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

I have already mentioned, that the first, or cubital row of the carpus, receives its synovial membrane, for its junction with the radius, from a prolongation of the membrane of the radio carpal articulation; but this joint is further strengthened by other ligaments, which connect the bones of this row firmly together, and are situated between these bones on their anterior and on their posterior surfaces.

Interosseous ligaments.—These are short but very strong ligaments, which connect the scaphoid, the lunar, and the cuneiform bones: they are composed of dense fibres, which are laterally united firmly to each bone; their superior face is covered with the synovial membrane of the radio-carpal articulation, to which they are attached.

The *anterior* or *palmar ligament* is found situated immediately under the anterior ligament of the wrist-joint, takes an oblique direction from without to within, being connected to the scaphoid, lunar, and cuneiform bones; and as it passes from one of these bones to the other, connects itself with the interosseal ligaments.

The *posterior* or *dorsal ligament* has attachment to the same bones as the palmar ligament; its posterior surface is in contact with the posterior ligament of the wrist-joint, and its anterior with the interosseous ligaments; it also tends to strengthen this row of the carpus.

Articulation of the Pisiform Bone.

This bone being situated anteriorly to the other bones of the carpus, has a peculiar articulation with the cuneiform, which is furnished with a synovial membrane covering the articulatory surface of each bone; it has also an inferior ligament, which connects it with the hamillary process of the unciform bone, and is further strengthened and maintained in its situation by the insertion of the flexor carpi ulnaris.

The Second or Digital Row of the Carpus.

The bones of this row are connected by interosseous, palmar, and dorsal ligaments, precisely similar to the cubital row; the fibres of which pass from without to within, in a transverse direction, from the trapezium to the unciforme, and are attached to the intermediate bones.

Articulation of the two Rows of the Carpus with each other.

This articulation consists of three distinct joints, viz., the trapezium and trapezoides with the scaphoid; the unciform with the cuneiform; and the os magnum with the lunar and scaphoid bones: the two first forming an arthrodial articulation, while the latter forms an enarthrodial joint. These joints are connected by external and internal lateral, anterior and posterior ligaments, and by synovial membrane.

The *lateral ligaments* appear to be nothing more than a continuation of the external and internal lateral ligaments of the radio carpal articulation; being attached, as they descend on the outer side, to the scaphoid and the trapezium; on the inner sine, to the cuneiform and unciform bones.

The *anterior* and *posterior ligaments* are formed of short, strong, fibrous fasciculi, which pass in various directions from the cubital to the digital row. They are situated immediately underneath the ligaments of the radio carpal articulation, with which they form a strong fibrous covering to the whole of the carpus.

The *synovial membrane* not only covers the articulatory surfaces by which the bones of the two rows of the carpus are connected with each other, but also insinuates itself between the bones of each row, so as to form a synovial cavity, prolonging itself both superiorly and inferiorly upon the articulatory surfaces of every bone, excepting the pisiform.

Articulation of the Carpus with the Metacarpus.

Articulation of the Metacarpal Bone of the Thumb with the Os Trapezium.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

This joint is connected by a strong *capsular ligament*, which is formed of longitudinal fibres, passing from the neck of the metacarpal bone of the thumb to the edge of the articulatory surface on the trapezium. It is loose, having its internal surface lined by synovial membrane, while its external surface, particularly, is strengthened by the muscles of the thumb.

Articulation of the four last Metacarpal Bones with the Carpus.

The four other bones of the metacarpus are connected with the carpal bones by *synovial membrane*, which is a continuation of that of the carpus, and by *dorsal* and *palmar* *ligaments*, proceeding from the inferior extremity of the digital row, to be attached to the necks of the metacarpus. Each of the metacarpal bones is furnished with as many fasciculi of palmar and dorsal ligaments, as it has attachments to bones of the carpus; for instance, the metacarpal bone of the fore finger has a fasciculus from the trapezium, trapezoid, and os magnum.

Articulation of the Bones of the Metacarpus with each other.

The metacarpal bone of the thumb is not connected with any other of the metacarpal bones. The rest are in actual contact posteriorly, and are furnished with small synovial capsules; and these articulations are strengthened by *dorsal* and *palmar* ligaments, which pass transversely from one bone to the other, forming rather one continuous surface than being separable into three distinct fasciculi, as generally described.

The inferior extremities of these bones diverge, but are connected by *transverse ligaments*, which are divided into two sets of fibres, a *superficial*, and a *deep:* the *latter* are the shorter, and exclusively deserve the name of intertransverse, passing from one bone to the other: their anterior faces are crossed by four depressions, which answer to the passage of the tendons of the flexor muscles of the fingers, and the lumbricales. Posteriorly, they are connected with the tendons of the interosseous muscles, and with the ligaments connecting the phalanges with the metacarpus. The *superficial* fibres pass across all the metacarpal bones, excepting that of the thumb, both on the *dorsal* and *palmar regions.*

Articulation of the Metacarpus with the Phalanges.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

The rounded inferior extremity of the metacarpus, is admitted into the cavity of the superior extremity of the first phalanx of the five fingers, and their joints are connected by anterior and lateral, which form capsular ligaments, and by a lining synovial membrane.

The *anterior ligament* is a half annular ligament, attached to the fore parts and sides of each metacarpal bone, immediately below their intertransverse ligaments, from whence it passes to be inserted into the superior extremity of each phalanx. It is in the thick part of this ligament that the sesamoid bones of the thumb are placed, between which its proper flexor muscle passes.

The *lateral ligaments* proceed from the sides of the inferior extremity of the metacarpal bones, as far as to the sides of the superior part of the phalanges. These ligaments are connected with the sheaths which protect the tendons of the flexor muscles, and their edges are in contact with the vessels and nerves of the fingers.

The *synovial membrane* covers the cartilaginous surface of the bones of the metacarpus, passes behind the anterior ligament and within the lateral, and surrounds the articular surface of the phalanx; it then forms a loose capsule under the tendon of the extensor muscle.

Articulation of the Phalanges.

Class *Diarthrosis.*—Subdivision *Ginglimus.*

The articulation of these bones with one another form a perfect hinge-joint; they have each a synovial capsule, an anterior, and two lateral ligaments, which, in situation and attachment, resemble so precisely those of the articulation of the phalanges with the metacarpus, as to render their description unnecessary.

Motions of the Carpus.

The two rows of the carpus which have already been described, as forming in part an arthrodial and in part an enarthrodial articulation, admit of some slight degree of motion upon each other; but yet this motion is rather to be considered as general, with respect to the whole hand, than in particular with the bones themselves. The direction in which their motion is permitted is extension and flexion; the former taking place to a greater extent than the latter. There is also some slight degree of motion between each of the bones of the carpus, but so limited that it is rather to be considered for the purpose of preventing injury to the hand from concussion, than to assist in the functions of the hand itself.

Motions of the Metacarpus upon the Carpus.

The four metacarpal bones admit of some slight degree of motion from before to behind. This cannot be described as flexion and extension only, allowing their surfaces to slide and not to turn upon the articulatory faces of the carpus. With this motion that of the bones of the metacarpus on each other may be included, which must necessarily admit of some sliding on themselves, to allow of their motion on the carpus.

Motions of the Phalanges on the Metacarpus.

In this description I include the motions of the thumb upon the carpus, having already stated the reasons for considering the thumb to be composed of three phalanges. The first phalanges of the four fingers execute a motion of flexion, extension, abduction, adduction, and circumduction, upon the metacarpus; while that of the thumb moves upon the os trapezium of the digital row of the carpus, and enjoys a much more extensive motion than the others. The articulations between the first and second, and second and third phalanges of all the fingers, form complete hinge-joints, and admit therefore only of flexion and extension, the former to a much greater extent than the latter. If we consider the combined motions of all the bones of the hand, we shall discover how admirably it is adapted for the facility with which it is able to perform the various motions necessary for its peculiar uses.

Practical Remarks.

Dislocations to which the Wrist-Joint is liable.

It sometimes happens, that the convex surfaces of the three first bones of the carpus are separated from the concave surfaces of the radius and interarticular cartilage; and it is possible for the carpus to be thrown either backwards, forwards, externally or internally; but, from the formation of the wrist-joint, the dislocation backwards is the most frequent; the convex articular surfaces of the three first bones of the carpus sloping in that direction.

Dislocation backwards.—This accident usually occurs from a fall upon the back of the hand while the hand is flexed; the force being then applied to the anterior extremities of the metacarpal bones, the carpus is tilted over the posterior surface of the radius, and a deformity immediately produced; which, with the consequent shortening and permanent flexion of the hand, render the nature of the accident at once sufficiently apparent. The posterior ligament of the wrist is necessarily torn through, and the lateral ligaments may have some of their anterior fibres ruptured.

Dislocation forwards.—This accident, which but rarely occurs, is usually produced by a fall on the palm of the hand during extension, and the carpus is driven before the radius: the hand is painfully extended and shortened, and the deformity considerable, but not so obvious as in the last described accident, particularly as the dislocation is scarcely ever complete, and the cavity of the hand renders its detection more difficult. In this dislocation the anterior ligament is torn through, and the lateral ligament is placed under the same circumstances as in the last described accident.

In the *lateral dislocations*, the displacement can never be complete; but a projection of the carpus on the inner or outer side, is a sufficient diagnostic mark of the nature of the injury. The degree of laceration of the anterior, posterior and lateral ligaments, is in proportion to the extent of displacement. In any of the dislocations of the wrist-joint, if the case be recent, reduction is easily accomplished by slight extension of the hand; therefore no time should be lost in reducing the bones to their natural situation, not allowing time for a fixed contraction of the muscles.

Dislocations of the carpus.—From what has already been said of the motions and general functions of these bones, their displacement from each other, without fracture, may be considered as almost impossible, although some authors have described cases in which the os magnum has been thrown from the cavity formed for it by the lunar and scaphoid bones upon the back of the hand, there forming a considerable tumour. The means to be employed for its reduction are sufficiently obvious: force should be applied upon the dorsal surface of the dislocated bone, while the hand is kept in an extended position ; and if these means are early employed, its replacement may be effected without much difficulty.

Dislocations of the metacarpus.—From the description which has been given of the formation of the articulations and motions of the metacarpal bones on the carpus, and of their connexion with each other, their dislocations must necessarily be of very rare occurrence; for a force sufficient for their displacement, would rather fracture the bones than produce their luxation, unless previous disease had destroyed the natural means of their connexion.

Dislocations of the phalanges.—The first phalanges present a concave surface, to receive the convex extremities of the metacarpal bones ; and in consequence of the rounded surfaces of these bones extending much further forwards than backwards, the first phalanx can scarcely be thrown into the palm of the hand, but is forced backwards on the metacarpal bones. This accident most frequently occurs to the thumb, and may be readily known by the deformity on the metacarpus, and by the extension of the first phalange, while the second is bent. The other phalanges are also liable to similar dislocations, which are not easily reduced, particularly if any length of time has elapsed between the accident and the attempt at reduction; for in consequence of the smallness and shortness of the dislocated phalanx, it becomes very difficult to apply, by any mechanical means, a sufficient force to restore the bone to its natural situation ; which, however, may be effected by the application of a piece of tape, fixed to the extremity of the dislocated phalanx in the form of a " clove hitch."

LECTURE X.

ARTICULATIONS OF THE PELVIS AND LOWER EXTREMITIES.

Articulations of the Pelvis.

The ligaments which serve to strengthen these articulations may be divided into two sets; those which attach the pelvis to the vertebræ, and those which connect the different bones of the pelvis with each other. There are but two of the first order which differ, in any respect, from the ligaments common to the vertebræ; for the superior surface of the sacrum is found connected with the last lumbar vertebra by an intervertebral substance; a continuation of the common anterior and posterior ligaments of the vertebræ also strengthens this connexion; capsular ligaments are found attaching the articular processes of the sacrum to the last lumbar vertebra; and, lastly, similar interspinous ligaments, and a continuation of the ligamentum subflavum, serve to connect them. There are, however, two others which require a particular description.

First, the *sacro lumbar ligament*, which arises from the inferior and anterior part of the transverse process of the last lumbar vetebra, and passes downwards and outwards, to be inserted into the superior part of the sacrum. This ligament is of a triangular form, its apex being above, where it is connected with the ilio lumbar, and its base being below; its fibres are intermixed with those of the ilio sacral ligament. Its anterior surface is covered by the psoas magnus muscle, while it covers posteriorly the fibres of the ilio lumbar ligaments.

Secondly, the *ilio lumbar ligament* arises from the transverse process of the last lumbar vertebra, and passes outwards to be attached to the posterior and superior spinous process of the ilium, extending as far downwards, anteriorly, as to be mixed with the fibres of the sacro ligaments; in this situation the ligament is divided into two sets of fibres, which gain the distinction of superior and inferior transverse ligaments of the pelvis. Above, this ligament is covered by the quadratus lumborum muscle; anteriorly, by the psoas magnus; and, posteriorly, it partially gives origin to the lumbar mass of muscle.

Articulations of the Bones of the Pelvis with one another.

Articulation of the Sacrum and the Os Coccygis.

CLASS *Diarthrosis.*—SUBDIVISION *Amphiarthrosis.*

This union is completed in the same manner with that which is common to the vertebræ; for the apex of the sacrum, and the base of the os coccygis, have corresponding oval surfaces, connected by a fibrous cartilaginous tissue, similar to the intervertebral substance, but not quite so thick; a continuation of the common anterior and posterior ligaments of the vertebræ, serve to strengthen this articulation, so that a further description of these ligaments is unnecessary.

Connexion of the Sacrum with the Ossa Innominata; or, Sacro Iliac Articulation.

This union, termed the sacro iliac symphisis, is formed by the junction of the sacrum and ilium, through the medium of an intervening cartilage.

The following ligaments serve to render this articulation firm.

The *posterior sacro sciatic ligament* arises from the posterior and inferior spinous process of the ilium, from the sides of the sacrum, and from the first bone of the os coccygis; then on either side passes outwards and downwards, to be inserted into the tuberosity of the ischium, being there connected with the tendinous origin of the flexors of the leg. Upon the inner side of this portion of bone it extends itself into a ligamentous expansion, from the shape of which it has gained the name of the *falciform ligament,* which runs up on the ascending ramus of the ischium, and forms a canal for the passage of the pudic artery, and also gives origin to the obturator internus muscle. From the posterior surface of this ligament arises the gluteus maximus muscle; its anterior face is connected with the anterior sacro sciatic ligaments, leaving a triangular space between them, which gives passage to the obturator internus muscle, and to the pudic vessels and nerves.

The *anterior sacro sciatic ligament* is the smaller ligament of the two, but of the same form as the last described, before which it is situated. It arises, in common with the posterior ligament, from the ilium, sacrum, and os coccygis, being composed of the most anterior fibres; it passes forwards and inwards, to be inserted into the spinous process of the ischium ; its posterior surface is covered by the posterior sacro sciatic ligament ; its anterior gives origin to the coccygeus muscle. These two ligaments divide the great sciatic notch into two openings ; through the upper, which is the larger, passes the pyriformis muscle, the gluteal, and sciatic vessels and nerves ; and through the inferior, the obturator internus muscles, with the pudic vessels and nerves. These ligaments exist not only for the purpose of connecting the bones of the pelvis, but also of sustaining its viscera, and diminishing the size of its openings.

The *sacro iliac ligaments* connect the sacrum and ilium, both anteriorly and posteriorly, passing from the two upper bones of the former to the sides of the ilium, and thus enveloping the intervening fibro-cartilaginous tissue ; the anterior sacro iliac ligament is covered by the psoas magnus, and the posterior by the gluteus maximus muscle. There are, however, several other irregular ligamentous fibres, connecting the ossa innominata with the sacrum; but their course is so indistinct and uncertain, as to render it unavailing and useless to attempt their description.

Articulation of the Pubes.

The pubes are connected, by the junction of their symphyses with an intervening fibro-cartilaginous substance, which is more thick anteriorly than posteriorly; and their union is rendered firmer by anterior and posterior ligaments, which pass transversely from the one bone to the other.

The *anterior ligament* is composed of transverse ligamentous fibres, which pass from one bone to the other, anterior to the intervening cartilage; it is connected with the periosteum of the pubes, and the aponeurotic expansion from the abdominal muscles.

The *posterior ligament* is stronger than the preceding; it is triangular, and is attached to the superior part of the arch of the pubes, passing some way down on the sides of the descending rami of this bone, and forming a slight curve, the concavity of which faces downwards. It produces the triangular ligament of the pubes; and, from its inferior edge, a strong fascia is given off, which separates the perinæum from the contents of the pelvis; admitting, however, the urethra to pass through it.

The *obturator ligament* comes particularly under consideration, as one of that class which is destined entirely for the purpose of presenting an extension of surface for the origin of muscle, and not for the usual office of binding bones together. It arises from the whole circumference of the obturator foramen, closing it every where, excepting at its upper part, where it leaves a small opening for the passage of the obturator vessels and nerves; its fibres take an irregular course, frequently intersecting one another. Its anterior surface gives attachment to the obturator externus;

and its posterior to the obturator internus, and part of the levator ani muscles.

Motions of the Pelvis.

The motions of the pelvis may be considered as twofold. First, as a whole, upon the vertebral column, and on the ossa femoris; and, secondly, with regard to the motions between the separate bones entering into its composition: but it is only to the latter that I shall call the attention of my readers at present. The degree of motion between any two of the bones entering into the formation of the pelvis is but very slight in the natural state; unless, indeed, we except the articulation between the sacrum and the os coccygis, which does allow of motion backwards and forwards. But this articulation still comes under the fair denomination of an immoveable joint, in contradistinction to those, which, being under the influence of the will, are moved, consequently, by the action of voluntary muscles, while this joint cannot be acted upon except by some compression, such as the expulsion of the fœtus, which pushes this bone backwards, or pressure from without, which gives it the contrary direction. The sacro iliac symphysis, and the junction of the pubes, will also sometimes admit of a slight degree of motion between them, from continued pressure during protracted parturition.

Practical Remarks.

Under any circumstance, however, the bones of the pelvis are so firmly connected as to preclude the possibility of dislocation, unless, indeed, such be the result of disease and subsequent ulceration. When these bones are exposed to the greatest external violence, we find them rather fractured than separated from each other at their articulatory surfaces. Should such an accident, however, by any possible degree of violence occur, the same means would be employed as in fracture of these bones,—the application of a broad bandage, so as to keep the parts in their relative position; and at the same time passing a catheter into the bladder, to ascertain whether or not injury be done to the urethra, with strict attention to the antiphlogistic treatment, form the best mode of managing these injuries.

Articulations of the Lower Extremities.

Articulation of the Femur with the Bones of the Pelvis.

Class *Diarthrosis.*—Subdivision *Enarthrodia.*

The *ilio femoral articulation* is produced by the union of the head of the femur with the cotyloid cavity of the os innominatum; but this cavity is not, with respect to the bone only, of sufficient depth to receive the whole of the head of the femur; for, in a recent state, we find it much more capacious than in a dried bone, from the addition of a fibro-ligamentous substance investing its circumference; by the assistance of which it so completely surrounds the head of the femur, as to allow of the motions of the hip-joint, without permitting the separation of one bone from the other—an effect which takes place in the various motions of the shoulder. The surfaces of both the ball and socket of this joint are every where covered with cartilage, excepting the points of attachment of the ligamentum teres. The following ligaments serve to strengthen this articulation: the *capsular*, the *interarticular* (or ligamentum teres), and the *cotyloid ligament*, all of them being lined by the synovial membrane.

Capsular ligament.—This ligament, which is the strongest and thickest in the body, surrounds the whole of the joint. It arises from the circumference of the acetabulum, and proceeds in a direction outwards and backwards, to be attached to the base of the neck of the femur, extending outwards to the pit of the trochanter major, and downwards to the trochanter minor; in the intermediate space it is connected with the linea quadrata. It is much less loose than the capsular ligament of the shoulder-joint, being formed equally for strength as for extent of motion, but in other respects it is analogous to it. Its thickness is very considerable, particularly before and above, where it is strengthened by an accessory ligament, which passes from the anterior and inferior spine of the ilium, to the fore part of the capsular ligament, with which it is firmly united. On the inner side, the fibres of the capsular ligament are often so much separated as to leave a space between them, exposing the synovial membrane; and again becomes strengthened by fibres, which pass downwards from the obturator foramen. The whole external face of the capsular ligament of this joint is covered by the insertion of muscles destined for the motion of the thigh-bone: its internal surface is lined by synovial membrane.

The *interarticular ligament*, or *ligamentum teres*, is composed of ligamentous fibres, which pass from the inner and fore part of the cotyloid cavity to a rough fossa on the head of the femur. Its form is that of a triangle, the apex of which is attached to the thigh-bone; and its base, which is bifurcated, forms two flattened bands, which pass around the circumference of the foramen produced by the cotyloid ligament passing over the notch of the acetabulum. The superior band is of less extent than the inferior, but both are attached to the cotyloid ligament.

Cotyloid ligament.—The circumference of the cotyloid cavity is surrounded by this fibro-cartilaginous substance, which renders it perfectly regular, and forms into a foramen the notch which is situated at the under and fore part of that cavity, leaving a space for the passage of blood-vessels to the ligamentum teres. It is connected with the bony edge of the acetabulum by a comparatively broad base, while its apex is a free border a little inclined inwards. Its internal surface is covered by the synovial membrane; its external is in contact with the capsular ligament.

Synovial membrane.—This membrane arises from the cartilage of the head of the femur; it is then continued along its neck as far as its base, from whence it becomes reflected on the capsular ligament, covering it throughout its whole extent; it then passes on the inner surface of the cotyloid ligament into the cavity of the acetabulum, at the bottom of which it forms folds or fimbriæ, for the purpose of enlarging the surface for the secretion of its fluid; but, from its appearance, it has gained the name of a synovial gland; from thence it passes along the ligamentum teres to the head of the femur,—the point at which we began our description. As this membrane passes along the ligamentum teres, it secludes it from its secreting cavity, precisely in the same manner as the abdominal viscera are secluded from the cavity of the peritoneum. The whole circumference of the head of the thigh-bone has many little granular substances on it, which appear to be folds of the synovial membrane; there is one, in particular, to be found immediately below the insertion of the interarticular ligament. This articulation is provided with blood-vessels and nerves from the obturator artery and nerve, just at their passage through the obturator foramen, and also from the circumflex arteries.

Motions of the Hip-Joint.

The motions of the hip-joint are much the same with those of the shoulder, excepting that the rotatory motions are to a much less extent, in consequence of the greater depth of the acetabulum, in relation to that of the glenoid cavity of the scapula, and of the comparatively stronger and shorter capsular ligament; but the joint is capable of flexion, extension, abduction, adduction, rotation outwards, rotation inwards, and circumduction.

First, flexion.—When the femur is flexed the thigh is bent upon the pelvis, and its inferior extremity is carried forwards; the great trochanter is thrust backward towards the sciatic notch; the head rolls in the acetabulum on its own axis. The capsular ligament is slightly stretched posteriorly; but, if flexion be carried to its greatest degree, the distension of the ligament becomes considerable, in proportion to the extent of action.

Secondly, extension.—This motion is produced by the inferior extremity of the thigh-bone being carried backwards; the trochanter major is brought forwards, and is situated immediately under the anterior and superior spinous process of the ilium. The capsular and interarticular ligaments are put upon the stretch, in consequence of the disposition of the head of the thigh-bone to leave the cotyloid cavity; it is forcibly pressed on the anterior part of its capsule, which is, in this situation, rendered stronger by the accessory ligament, as before described.

Thirdly, abduction.—In this action the thigh is separated from the other laterally; the great trochanter is, when abduction is carried to its fullest extent, brought into contact with the dorsum of the ilium; the internal part of the capsular ligament and ligamentum teres are stretched.

Fourthly, adduction.—This motion consists of little more than the return of the limb to its natural position, after abduction has been performed; but it can be carried to a greater degree, so as to make the superior extremity of one thigh-bone cross the other; in which case the trochanter major is carried a little below, and anterior to, its natural situation. The capsular and interarticular ligaments are somewhat stretched.

Fifthly, rotation.—This may be either *outwards* or *inwards;* the former action seems to be more consistent with the position of the limb; and we find, therefore, an infinitely greater muscular apparatus to produce it, than to roll the thigh inwards. When this motion is carried to its greatest extent, the great trochanter is thrown behind the acetabulum, and the head of the bone is thrown forward, pressing against the capsular ligament. In the latter case the inferior extremity of the femur is turned inwards, and the trochanter so brought forward towards the spine of the ilium, as to make a perceptible projection under the skin; and the head of the bone turns upon its own axis, towards the back part of the acetabulum. In these rotatory motions, the foot should not be made the guide by which we can judge of their extent, as that is influenced by the motions of all the joints of the inferior extremity.

Sixthly, circumduction.—This is produced by the quick succession of all the motions of which the hip-joint is capable; and, as might be supposed from the structure of the joint, is limited to a considerably less extent than that in the shoulder. The ligaments and muscles adapt themselves to each motion as rapidly as they occur.

Practical Remarks.

Dislocations of the Hip-Joint.

Having ascertained the motions of which this joint is capable, we may easily understand the different directions in which the head of the thigh-bone may be thrown from the acetabulum.

First, upwards and backwards upon the dorsum ilii.

Secondly, downwards and forwards into the foramen ovale.

Thirdly, backwards into the ischiatic notch.

Fourthly, forwards upon the pubes.

Dislocation upwards and backwards on the dorsum ilii.—This is the most frequent luxation of the thigh-bone; and although in many respects it offers the same diagnostic marks as the other dislocations, yet there are some peculiar circumstances which render the nature of the accident at once obvious; and its most prominent characteristic is, the great degree of shortening of the limb, its rotation inwards, so as to bring the trochanter major much nearer to the anterior superior spinous process of the ilium; the foot, on the injured side, rests upon the tarsus of the opposite one, and the knee is partly flexed, and in advance of the other. The roundness of the hip is lost, in consequence of the ascent of the head of the thigh-bone upon the dorsum of the ilium, and the consequent relaxation of the glutei muscles; the pyriformis is somewhat relaxed, but the obturatores gemini and quadratus muscles are stretched. The psoas and iliacus are put upon the stretch, in consequence of their being drawn over the body of the pubes; but the other muscles arising from the pelvis, and inserted into the bones of the lower extremity, below the trochanter major, on account of the approximation of their points of attachment, are relaxed. The capsular ligament is torn through, so as to admit of the escape of the head of the bone, and the ligamentum teres is also lacerated.

The accidents with which this dislocation may be confounded are, the luxation of the head of the thigh-bone into the ischiatic notch, and the fracture of its neck; from the first it may be distinguished by the great degree of shortening, which causes the toe of the injured side to cross the tarsus of the opposite foot; while in dislocation into the ischiatic notch, the toe, on the dislocated side, is only directed to the ball of the great toe on the other. From fracture of the cervix femoris it is easily distinguishable, if but common attention be paid, for there is nothing similar in the two accidents excepting the shortening of the limb; the fixed position of the joint in dislocation, and its moveable state in fracture, will at once preclude the possibility of mistaking one injury for the other.

Dislocation of the thigh-bone downwards and forwards into the foramen ovale.—The diagnostic marks of this injury are so completely characteristic, as to render its nature at once obvious. The limb is lengthened to a considerable degree, the thighs are widely separated from one another, and the knee of the injured limb is advanced; the foot is somewhat everted, and the toes only rest upon the ground; the pelvis is bent upon the thighs, in consequence of the state of tension incident to the psoas and iliacus muscles, and a flatness of the thigh is produced by the extended state of the muscles situated upon it. The head of the bone can be felt deeply seated on the inner and superior part of the thigh; the trochanter major is considerably removed from the anterior superior spinous process of the ilium; and the voluntary motion of the extremity is totally lost. The capsular ligament is lacerated, as well as the ligamentum teres, although some have said that the latter is not necessarily torn through; but the head of the bone cannot be thrown completely out of the acetabulum, in any direction, without producing such a consequence. The increased length of the limb, the separation of the thighs, and the bending of the body, are, therefore, the principal diagnostic symptoms.

Dislocation forwards on the pubes.—This is an accident of rare occurrence, compared with the two preceding; but it does occasionally take place, and may be at once known from any of the other luxations to which the thigh-bone is liable, by the outward rotation of the whole limb, by the head of the bone being felt just above Poupart's ligament in the situation of the anterior crural nerve, upon which it sometimes presses so as to produce numbness and pain. The trochanter major is nearer to the anterior superior spinous process of the ilium; and the impossibility of producing rotation inwards of the injured limb, sufficiently marks the nature of the accident.

This dislocation is the accident of all others most liable to be confounded with fracture of the neck of the thigh-bone; being alike characterized by shortening of the limb, and eversion of the foot; but the fixed state of the limb in dislocation, and the comparative facility with which it may be moved in fracture of the neck, form an unequivocal distinction.

Dislocation backwards into the ischiatic notch.—In this case the head of the bone is thrown behind the acetabulum, and a little above the centre of that cavity; so that the limb is somewhat shortened, and the foot inverted, with the great toe on the injured side resting on the ball of the opposite one. From the depth at which the head of the bone is placed, it is with difficulty felt resting on the pyriform muscle. This dislocation is, in every respect, the most difficult to discover; but the points to be observed are, the loss of motion of the joint, accompanied by but slight shortening of the limb, not more than to half an inch, and by inversion of the foot. With respect to the modes of reduction of the dislocations of the hip-joint, it should be remembered by the surgeon, that his sole opposing force is muscle; and, therefore, that it is quite essential for him to understand the position of these organs under the different luxations of this joint, that his judgment may decide on the best means of placing them under those circumstances, in which they can offer the least opposition to his efforts in reduction; at the same time recollecting the necessity of the perfectly fixed state of the pelvis.

Having perfectly fixed the pelvis and relaxed the muscles of the hip-joint, the next object is to apply a sufficient extending force to reduce the limb; upon this subject there is some discrepency of opinion, as to the most advantageous situation for its application: some authors asserting that the inferior extremity of the femur is the best, being then applied to the dislocated bone itself; while others recommend its application to the ancle-joint, in order to remove it as far as possible from the opposing muscles, added to which, advantage may be gained from the increased length of the lever. The benefit resulting from this latter practice is frequently manifested, by surgeons succeeding to reduce dislocations of the humerus, by making extension from the wrist, after the application of the force to the bone itself has failed.

Articulation of the Knee; or, Femoro Tibial Articulation.

CLASS *Diarthrosis.*—SUBDIVISION *Ginglymus.*

This is one of the most complicated joints in the body, and is produced by the union of the following bones:—The condyles of the femur, the superior extremity of the tibia, and the posterior surface of the patella, being covered in their recent state by articular cartilage, adapt themselves for the performance of the varied functions of this joint. These cartilaginous surfaces are covered by synovial membrane, to facilitate motion; and the following ligaments serve to prevent lateral movement, while they admit of flexion and extension.

The ligaments of the knee-joint may be divided into two sets: those which are external, and those which are internal. The latter, however, it must be remembered, are without the synovial cavity, although nearer to the centre of motion than the former class. The external ligaments of the knee-joint are, an anterior, or ligamentum patellæ; a posterior, or the ligament of Winslow; two external, and one internal lateral ligaments.

The *ligament of the patella* is, in fact, nothing more than a continuation of the tendons of the extensor muscles of the leg, which completely envelop the patella, becoming attached to its inferior edge or apex, and passing from it to the tubercle of the tibia; anteriorly, it is covered only by skin, and by a prolongation of the fascia lata; its posterior surface is in contact with fat and the synovial membrane of the joint, and below a bursa is formed between it and the tibia; its edges are in contact with the tendinous insertion of the vasti, and with that portion of the synovial membrane which gains the name of the alæ ligaments. The fibres of this ligament pass from above to below in parallel lines, which are strengthened by cross bands. It is generally about two inches in length, and is sufficiently strong to counterbalance the action of the extensor muscles.

The *long external lateral ligament* is posterior to the centre of motion, so as not to be put upon the stretch under the various actions of the joint. It is composed of vertical fibres, which descend from the external condyle of the femur to be attached to the head of the fibula; it is covered in a great part of its extent by the tendon of the biceps muscle, and its inner surface is applied to the external semilunar cartilage, and to the synovial membrane. The inferior articular vessels pass between this ligament and the bone. The origin of the external lateral ligament from the femur, is above and behind the origin of the popliteus muscle.

The *short external lateral ligament,* which appears to be an accessory to the other, is placed posteriorly to it, and running in a parallel line, passes from the outer side and posterior part of the external condyle, downwards, to the head of the fibula, to which it is attached. These two ligaments are connected with each other by a strong cellular tissue.

The *internal lateral ligament* is also posterior to the centre of the joint. It is of a triangular form, its apex arising from the posterior part of the internal condyle of the femur, and its base being attached to the internal edge of the head of the tibia; its fibres are more flattened than the external ligaments of the knee-joint; it is rather thicker before than behind, where it is connected with the posterior ligament of Winslow by a strong aponeurosis. This ligament is covered above by the insertion of the vastus internus, and below by the sartorius, gracilis, and semitendinosus muscles; the ligament itself covers the synovial membrane, and is connected with the internal semilunar cartilage.

The *posterior ligament* forms a great protection to the back part of the joint. It passes transversely from without to within, arising from the external condyle of the femur, and being inserted into the back part of the tibia, where it is intimately connected with an aponeurotic expansion from the tendinous insertion of the semimembranosus muscle; which muscle, in flexion of the knee, prevents this ligament from being pressed between the bones. This, at least, is the function usually ascribed to the attachment of that muscle to the posterior ligament; but I believe a much more important purpose may be assigned to it,—that of keeping the semilunar cartilages in their natural position under all the various motions of the joint. Its fibres take an irregular course, leaving several apertures for the transmission of blood-vessels; its posterior surface is covered by the popliteus muscle, its anterior is in contact with some fat which is interposed between it and the posterior crucial ligament, leaving a space for the transmission of the middle articular vessels.

The second class, or those ligaments which are described as within the knee-joint, though without the synovial capsule, are the following.

The *anterior crucial ligament*, which arises from the inner and back part of the external condyle, and is directed obliquely downwards and forwards to a depression in the front part of the spine of the tibia, to which it is attached between the anterior cornua of the semilunar cartilages: it is covered before by the synovial membrane, and is in contact behind with the posterior crucial ligament. This is the ligament, which, in the semiflexed position of the knee-joint, prevents the rotation of the tibia inwards, excepting in a very slight degree.

The *posterior crucial ligament* crosses the direction of the preceding, arising from the internal condyle, and passing outwards, although not with the same degree of obliquity as the anterior, to be attached to the posterior part of the spine of the tibia; its course is but little out of the vertical line; its base, which is connected with the tibia, is continued to be attached to the external semilunar cartilage; behind, it is covered by the posterior ligament of the joint, and by the middle articular arteries; while before, it is applied to the anterior crucial ligament.

The *semilunar cartilages* are situated between the condyles of the femur and the upper face of the tibia, which they render more concave: they are, as their name implies, of a semilunar form, and much thicker at their greater than at their smaller circumference; they are less in extent of surface than the upper part of the tibia, not occupying more than its two external thirds, and are distinguished according to their relative situation, into internal and external.

The *internal* is nearly semicircular, rather longer and larger behind than before; its convex edge is turned inwards, and is connected with the internal lateral ligament; its anterior extremity is attached to the spine of the tibia, and to the anterior crucial ligament; its posterior extremity is fixed to the tibia, and to the posterior ligament of Winslow.

The *external* forms a greater share of the segment of a circle than the preceding; is larger before than behind; its convex edge is turned outwards, and is in contact behind with the popliteus muscle; in the middle part, with the external lateral ligament; and in the fore part with the tibia, being placed behind the anterior extremity of the internal cartilage; while behind, it is anterior to the corresponding extremity of its fellow. These cartilages are composed of fibres, which are more perceptible in their convex than concave edges; they are anteriorly connected to one another by a short *transverse ligament;* their superior surfaces are concave, their inferior flattened, and both are covered by synovial membrane, which is reflected under their free concave edges. These two ligaments together, resemble the interarticular cartilages of other joints; leaving, however, a large opening between the two synovial cavities, which they have a tendency to separate.

The *synovial membrane* takes a course rather difficult to trace, as it lines the inner surfaces of all the ligaments, as well as the cartilaginous surfaces of the bones entering into the composition of the knee-joint. We will first trace it from the inner surface of the extensor tendons of the leg, just as they are inserted into the patella. From this point it proceeds upwards, lining the under surface of this tendon as high as the condyles of the femur, upon which it then becomes reflected, forming a *cul de sac* between the two; it passes round the extremity of the femur, as far backwards as the posterior ligament; at the same time surrounding the crucial ligaments, so as to leave them posterior to its cavity. From thence it is continued on the superior surface of the semilunar cartilages, lining also the external and internal lateral ligaments; it then dips under the concave free edges of the semilunar cartilages, covers the whole superior articular surface of the tibia, and proceeds from the anterior point of this bone to the inner surface of the ligament of the patella, extending laterally to the anterior edges of the two lateral ligaments. These at the points where they are attached to the edges of the ligamentum patellæ, are called the *alæ ligaments* It then rises upon the inner surface of the patella, and passes from its base upon the tendon of the extensor muscles, from whence we began the description. There is also a portion of the synovial membrane which passes from the tibia, like a chord, to the femur, between its condyles, and which is called the *mucous ligament*; it is composed of a number of little fimbriated processes, which receive the ramifications of the articular arteries.

Motions of the Knee-Joint.

The articulation of the femur with the tibia forms a complete hinge-joint, which is anteriorly protected by the patella. With respect to the motions of this joint, it is capable of flexion, extension, and some slight degree of lateral motion, during the flexed position of the leg. When the limb is flexed, the leg is capable of being carried very far back, so as to form an acute angle with the thigh; during which motion, the semilunar cartilages are drawn backwards by the action of the semimembranosus muscle; and the patella, as the femur and the tibia recede from each other, remains stationary, so as to protect the knee-joint, which would otherwise have been much exposed in this action. This extensive motion of flexion is allowed, in consequence of the larger articular surfaces of the condyles of the femur, upon which the tibia moves, being placed posteriorly. In extension, the leg cannot be carried further forwards than to the straight line, during which action no lateral motion can take place in the knee-joint; and from the condyles of the femur being pressed against the origin of the gastrocnemii, greater stability is given to the limb. The motions of the limb during the extension of the knee, are effected by the hip-joint; but in flexion, the tibia and femur move upon each other. During slight flexion, such as takes place in progression, we are capable, from the degree of lateral motion which under these circumstances the joint enjoys, to direct our steps, by a rotatory motion of the tibia on the femur, in a lateral direction; but this can take place to a much further extent outwards than inwards, in consequence of the attachments of the anterior crucial ligament. Whenever, therefore, latera motion can be performed by the knee-joint, that limb is under circumstances least capable to resist accidents, or to support the weight of the body, which, therefore, is thrown entirely upon the other extended extremity, as we find to be the case in the act of walking.

Practical Remarks.

Dislocations of the Knee.

Dislocations of the Patella.—This bone being situated on the anterior part of the knee-joint is much exposed to external violence, and is proportionably liable to injury; amongst other accidents, it is subject to dislocation, which may take place either outwards or inwards.

The *dislocation outwards* is the most frequent; it is, however, scarcely ever complete, unless it be from a very relaxed state of the ligaments, produced by some prior disease; but is usually thrown upon the external condyle, there forming a tumour, attended with loss of motion of the joint, which circumstances sufficiently point out the nature of the injury. This accident is frequently produced by a blow on the inner side of the patella when the foot is everted, or it may be caused merely by the action of the extensor muscles of the leg; and in this case it most frequently occurs to such persons who have their knees directed very much inwards. If the dislocation be complete, the articular surfaces of the patella are thrown upon the external surface of the condyle, and its inner edge is placed anteriorly, which cannot take place without partial laceration of the ligamentum patellæ; unless, as I have before remarked, the accident be subsequent to the relaxation of the ligaments of the knee-joint from disease.

Dislocation inwards.—The appearances and symptoms differ in no respect from those of the preceding injury, excepting that the projection is situated internally instead of externally.

The *dislocations upwards* and *downwards*, which are spoken of by some surgeons, do not appear to me to deserve such appellation; but ather to be spoken of as either laceration of the ligamentum patellæ, when the bone is drawn upwards by the action of the extensor muscles, or as rupture of the tendon of the extensor muscles, when the patella is forced below its natural position.

The *mode of reduction*, when the patella is thrown either outwards or inwards, must at once be obvious to every surgeon; his object would be to place his only opposing force, the extensor muscles of the leg, in the greatest state of relaxation, which may be easily performed by laying the patient in the horizontal position, with the injured leg extended, and the thigh flexed; and then, by forcing the patella either inwards or outwards, according to the direction of the luxation, it is easily reduced. These means should be employed as soon after the accident as possible, and bandages subsequently used, to keep the bone in its natural position; from which it would otherwise be easily again displaced by muscular action alone.

Dislocations of the tibia.—The tibia may be thrown from the articular surfaces of the condyles of the femur in four directions; but in consequence of the large surfaces of bone which are in contact for the formation of this joint, luxation is but rarely complete, and never without being accompanied with very extensive laceration of soft parts, unless, indeed, it be the result of protracted disease. But whatever may be the cause of displacement, the deformity is so great as at once to indicate the nature of the injury.

The tibia may be thrown forwards, backwards, or laterally, to either side of the knee.

Dislocation forwards.—In this luxation the head of the tibia is thrown before the condyles of the femur, which are thrust deeply into the popliteal region, so as to compress the popliteal artery. The leg is shortened, this effect being produced by the laceration of the crucial, lateral, and posterior ligaments; the extensor muscles of the foot, as well as the popliteus, must inevitably be stretched almost to laceration.

Dislocation backwards.—In this case the head of the tibia rests in the popliteal space; the leg is projected forwards by the pressure of the condyles of the femur upon the tubercle of the tibia; and the tendinous insertion of the extensor muscles of the thigh into the patella is torn through, leaving a depression above. Such is the account of this accident as given by Sir Astley Cooper, with whom some surgeons differ as to the position of the leg, whether it be inordinately extended, or permanently flexed; but as Sir Astley Cooper's description is derived from the history of a case furnished to him by an able and zealous professional man, under whose care the subject of the accident was placed, I shall esteem the account as positive, and not to be refuted by theoretical reasoning.

In the *lateral dislocations*, the projecting deformity sufficiently points out whether the luxation be *inwards* or *outwards;* in the first case the tibia is so thrown inwards, as to receive the external condyle on its outer articulatory surface, and the tibia projects on the inner side of the joint. Appearances precisely similar, excepting in situation, occur in the displacement of the tibia outwards.

The semilunar cartilages are sometimes partially displaced by the pressure of the femur, in consequence of relaxation of the ligaments of the knee-joint. This accident was first observed by Mr. Hey, of Leeds, and the symptoms have been most perspicuously and scientifically described by him, in his "Practical Observations on Surgery."

In few cases of dislocation of the tibia is there much difficulty in returning the bone to its situation, by reason of the laceration of the ligaments; but great care is required to relax the muscles inserted into it, that their action may not again displace the bone. This object is best effected by bandages, and by the semiflexed position of the limb.

The constitutional remedies will, necessarily, be directed by the peculiarities of each particular case.

Articulation of the Tibia and Fibula.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

These two bones are in close contact at each extremity; but in the intermediate space there is a natural separation between them, which is filled up by the interosseous ligament. In this respect they are similar to the bones of the fore arm, excepting that they are comparatively firmly fixed to each other, while a very considerable degree of motion is allowed between the radius and the ulna.

Upper Fibulo Tibial Articulation.

There is a depression on the outer side of the head of the tibia, and a corresponding surface on the fibula, for the attachment of these two bones; each is covered with cartilage and synovial membrane, and their union is strengthened by an anterior and posterior ligament.

The *anterior ligament* is of considerable strength and size. It passes from the outer part of the tubercle of the tibia outwards and downwards, to be attached to the head of the fibula, and is covered and rendered stronger by the tendon of the biceps muscle.

The *posterior ligament* takes a very similar course to the preceding, being placed behind the articulation; its fibres are less strong, but support is afforded to it by the popliteus muscle, by which it is covered.

A *synovial membrane* lines the internal surface of both these ligaments, as well as the cartilaginous surface of the bones.

Notwithstanding the firmness of this junction, there is some slight degree of motion, from before to behind, between the upper extremities of the tibia and fibula; luxation does sometimes occur, either from relaxation of its ligaments, or the application of force, and the fibula may, from either of these causes, be thrust backwards; it is, however, easily replaced, but with difficulty retained in its situation, in consequence of the action of the biceps muscle; a strap should therefore be firmly applied, to retain it in its situation.

I had an opportunity of seeing this accident at Guy's Hospital, which was admitted under the care of my colleague and relative Mr. Key. In this there was a compound dislocation of the head of the fibula backwards from the tibia, attended with fracture of the fibula; the bone was so comminuted as to require the removal of its dislocated head: nevertheless, the patient recovered without sustaining any important alteration in the functions of the limb.

Middle Fibulo Tibial Articulation.

The tibia and fibula are connected nearly throughout their whole course by the *interosseous ligament*, which, as in the fore arm, fills up the natural separation of the two bones. It presents an aponeurotic expansion, composed of oblique fibres, which extend from within to without, arising from the external edge of the tibia, and passing to the inner spine of the fibula, terminating below on that bone, so that it extends lower on the outer than on the inner side; and, as it forms an opening just above its termination, its lowest fibres, which pass from the inner side of the external malleolus to the tibia, are called the *inferior interosseous ligament,* which serves very considerably to protect the ancle-joint. The anterior surface of the interosseous ligament is covered by the flexor muscle of the foot, the extensors of the toes, and the anterior tibial vessels and nerve; its posterior face covers the extensor of the foot, and the flexors of the toes. At the upper part of this membrane there is an opening for the transmission of the anterior tibial vessels, and some of the fibres of the tibialis posticus muscle. Through the lower interosseal opening, which I have already described, there passes a branch of the peroneal artery.

Inferior Fibulo Tibial Articulation.

This articulation is formed by two triangular articular surfaces; that on the fibula being convex, and that on the tibia concave: both these surfaces are covered by cartilage: the synovial membrane of the ancle-joint lines their internal surfaces, and the following ligaments strengthen their union.

The *anterior ligament* is triangular, larger below than above, and it passes from the lower extremity of the fibula to the fore part of the tibia. Its anterior surface is covered by the tendon of the peroneus tertius muscle; it serves to strengthen the articulation of the astragalus with the tibia and fibula, by rendering the cavity deeper in the anterior part.

The *posterior ligament* is composed of two fasciculi, separated from one another by an intervening space; the inferior fibres are sometimes called the *inferior posterior ligament.* They both, however, arise from the back part of the malleolus externus, and pass inwards to be inserted into the back part of the tibia. The inferior fasciculus, or inferior posterior ligament, is longer than the superior, and crosses so behind the articular surface of the astragalus, as to prevent its luxation backwards. They together serve the same purpose as the anterior ligament, in rendering the articulation of the astragalus with the tibia and fibula much more secure, as well as in connecting those bones firmly together.

Articulation of the Astragalus with the Tibia and Fibula, or Ancle-Joint.

CLASS *Diarthrosis.*—SUBDIVISION *Arthrodia.*

The inferior extremities of the tibia and fibula form a socket for the reception of the upper part of the astragalus; this socket is rendered much deeper by the projection of the two malleoli on either side of the astragalus, and it is further completed by the anterior and posterior ligaments, which have just been described, connecting the tibia and fibula below. The surfaces of bone entering into this joint are covered by cartilage and synovial membrane, and are maintained in their situation by two ligaments from the tibia, and three from the fibula.

The *internal lateral*, or *deltoid ligament*, is of a triangular form; its apex is attached to the internal malleolus; it then passes downwards, becoming broader as it descends, and is inserted into the inner side of the astragalus and os calcis; forming, where it is attached to the other bone, a sheath for the transmission of the tendons of the long flexors of the toes and the tibialis posticus, which pass behind the internal malleolus to be inserted. There is also an *anterior ligament* from the tibia, which passes from the fore part of this bone to be attached to the anterior surface of the astragalus; and from the manner in which this ligament is connected to the lateral ligaments by condensed cellular membrane, the ancle-joint is sometimes described as having a complete capsular ligament: the tendons of the extensor muscles of the toes pass over it.

The *external lateral*, or *middle perpendicular ligament of the fibula*, is composed of straight fibres, which are strong, and rounded in their form, passing from the inferior extremity of the malleolus externus perpendicularly downwards, to be inserted into the upper part of the os calcis; its external surface is covered by the tendons of the peronei muscles; internally, it is lined by synovial membrane.

The *anterior ligament of the fibula* arises from the anterior part of the external malleolus, and passes downwards and inwards to be attached to the fore part of the astragalus.

The *posterior ligament of the fibula* takes much the same course as the preceding ligament, but is situated behind the joint; it passes from the back part of the malleolus externus, and is inserted at the posterior part of the astragalus, into the outer edge of the groove which lodges the tendon of the flexor longus pollicis muscle. This ligament sometimes is divided into two fasciculi, the upper one being its origin from the fibula, connected with the posterior ligament of the inferior tibio fibular articulation.

Synovial membrane.—This membrane secretes a larger quantity of synovia than any in the body. It extends from the cartilaginous surfaces of the tibia and fibula upwards, between these two bones, as high as the inferior tibio fibular articulation. It then prolongs itself on the cartilaginous surfaces of the two malleoli, covers all the ligaments of the ancle-joint, and rises upon the articulatory surfaces of the astragalus; before and behind it is very lax, and is connected with a considerable quantity of adipose membranes.

Motions of the Ancle-Joint.

The foot, through the medium of the ancle-joint, has the motions of flexion, extension, and lateral inclination.

Flexion.—During this motion the astragalus passes from before backwards, within the cavity formed by the tibia and fibula. The anterior ligaments are relaxed, and the posterior are put upon the stretch; but the lateral remain much in their natural state.

Extension.—In this action the foot is carried from the right angle with the leg, so as to form an obtuse angle; the anterior part of the articular surface of the astragalus leaves the cavity between the tibia and fibula in the opposite direction to that in which it was kept by the last motion; and the posterior and smaller part of the astragalus passes forwards. In this action the lateral motion of the joint is allowed, in consequence of the comparatively smaller size of the astragalus behind, by which it is incapable of filling up the whole space between the tibia and fibula. During extension of the foot the anterior ligament is put upon the stretch, the posterior is relaxed, while the lateral remain unaltered as to their degree of tension.

Lateral motions are extremely confined under every position of the joint; in fact, they can scarcely be separately distinguished from the motions of the bones of the tarsus between each other. They may, however, be performed to some small extent under the circumstances that exist during the extension of the foot, as already described; and, therefore, this being allowed, a circular motion must be ascribed to the joint, although it is capable of performing it only to a very confined extent, even in this position; in which state, the foot enjoying the greatest degree of motion, it is then in the position of all others in which the ancle-joint is liable to injury: while, on the contrary, in the erect posture, when this joint is sustaining the whole weight of the body, it is in its firmest state, and best capable of resisting injury from external violence.

Practical Remarks.

Dislocations of the Ancle-Joint.

Notwithstanding the numerous and strong ligaments which serve to connect the tibia and fibula with the bones of the tarsus, yet, from the great degree of violence to which the ancle-joint is constantly exposed, luxation does frequently occur; and as it is usually attended with great injury and laceration to the parts entering into the composition of the joint, the accident is one of a dangerous nature.

The astragalus may be thrown from the tibia in four different directions; but the fibula, having its ligaments so strong in proportion to its articular surface, usually breaks, rather than separate from its connexion with the astragalus.

The tibia may be thrown inwards, outwards, forwards, or backwards. The *dislocation of the head of the astragalus inwards* is the most common; and in this accident the sole of the foot being turned outwards, its inner edge only rests upon the ground; the internal malleolus is depressed, and occupies a space on the inner side of the astragalus below its articular surface; the fibula is broken about two inches above the joint, and the lower portion is drawn by the tibia across the astragalus; the external malleolus remains in its natural situation. If this accident be produced by a person jumping from a considerable height, that portion of the tibia which is connected to the fibula by the anterior and posterior ligaments is liable to be broken off.

Dislocation of the astragalus outwards.—This accident is attended with comminution of bone, and considerable injury to soft parts; and in every respect offers a less favourable prognosis than the preceding luxation. The sole of the foot is turned inwards, resting on the outer edge; the malleolus internus is broken off the shaft of the tibia; and the fibula, at its lower extremity, is usually fractured. But it is said sometimes to happen, that the ligaments connecting the fibula to the tarsus are ruptured; and, in that case, the bone remains whole. The external malleolus projects forcibly on the outer side of the foot, so as to threaten the laceration of the skin.

Dislocation of the astragalus backwards is produced by the tibia passing forwards off the articular surface of the astragalus, and resting upon the navicular bone; the consequences are great shortening of the foot between the lower part of the leg and extremity of the toes, together with elongation of the heel; the foot is extended and fixed in this position, admitting of no motion; the fibula is broken, its ligaments of course remain whole; but some of the posterior fibres of the deltoid ligament are ruptured. This dislocation is sometimes only partial; one half of the articular surface of the tibia resting upon the astragalus, while the anterior half projects forward over the navicular bone; the foot is extended, and the fibula broken; but it may be at once distinguished from the complete luxation, by the shortening of the foot and elongation of the heel being infinitely less than in the preceding accident.

Dislocation of the astragalus forwards.—This is an accident of extremely rare occurrence, for it appears never to have fallen under the observation of any author who has written upon the subject of dislocation; but should it occur, the lengthened state of the anterior part of the foot, with the shortening of the heel, would at once be sufficient diagnostic marks to point out the nature of the injury. Luxations incident to the ancle-joint, may occur in the compound as well as in the simple state; and the grand distinction between the two accidents is, that in the latter case the synovial cavity is laid open by the laceration of the skin, and the articular surfaces of bone are exposed. Even in these accidents it is now proved by experience, that amputation is not the necessary resort; for if there be youth and constitution, the preservation of the limb should be attempted in every case where there is not a division of any large blood-vessel, or any extraordinary degree of laceration of the soft parts; and it may very frequently be effected by strict attention to the unfavourable symptoms that supervene, and the judicious application of remedies to overcome them.

With respect to the reduction of these dislocations, whether simple or compound, the means should be employed as soon as possible after the accident; and in all cases the leg should be flexed, which relaxes the opponent muscles, and the foot supported by splints.

Articulations of the Bones of the Tarsus.

The bones of the tarsus are, at those points in which they come in contact, covered with cartilage and synovial membrane; and their attachments are strengthened by strong ligaments, which may be distinguished on the plantar, dorsal, external and internal regions of the foot.

Articulation of the astragalus with the os calcis.—These two bones are articulated by two cartilaginous surfaces, which are covered by synovial membrane, and maintained in their situation by an interosseous, a posterior, and an external lateral ligament.

The *interosseous ligament* is formed of strong thick fibres, which are situated between the astragalus and os calcis, being attached to the fossæ which separate the articular surfaces on each of those bones. This ligament is thicker on the outer than on the inner side.

The *posterior ligament* arises from the back part of the astragalus, and directs itself obliquely inwards to be inserted into the corresponing part of the os calcis; it is connected with the groove which is formed in the os calcis for the passage of the flexor tendon of the great toe.

The *external ligament* forms a rounded fasciculus, the fibres of which run in the same direction as the external fibulo tarsal ligament, passing from the external face of the astragalus to the outer surface of the os calcis.

Articulation of the os calcis and os naviculare.—In this articulation the surfaces of bone are not in contact, but the union is formed by two very strong ligaments,—the inferior or subastragular, and external ligament.

The *inferior* or *subastragular ligament* is very firm, and almost cartilaginous in its texture: it extends from the smaller tuberosity of the os calcis as far as the inferior surface of the scaphoid bone: in its passage from one bone to the other it rests, below, upon the tendon of the tibialis posticus muscle; and above, it receives a portion of the astragalus. It is this ligament which is of such essential service in preventing violent concussion to the foot on jumping from a height; for being rather fibro-cartilaginous than true ligament, its elasticity, combined with its flexibility, renders it well calculated to resist injury from external violence.

The *external ligament* is composed of very short fibres, which stretch from the anterior part of the calcis, to the inferior and outer edge of the scaphoid bone.

Articulation of the astragalus to the os naviculare.—The anterior extremity of the astragalus is rounded and fitted to a concave surface upon the posterior extremity of the navicular bone, both of which surfaces are covered by synovial membrane, and strengthened by one broad superior ligament, which covers the whole superior surface of the two bones: it is composed of very thin fibres, which are directed from behind to before. Some of its anterior fibres pass to the cuneiform bones.

Articulation of the calcis to the cuboid bone.—The articular surfaces of these two bones, which are in contact, are maintained in that situation by two ligaments, and covered by synovial membrane.

The *superior ligament* stretches from the superior and anterior part of the os calcis, to the superior surface of the cuboid bone. This ligament covers the synovial membrane, and is covered by the peroneus tertius muscle.

The *inferior ligament* is very thick and extensive: it is composed of two sets of fibres, the superficial and the deep. The *superficial ligament* is the strongest of the tarsal ligaments: it is attached, behind, to the posterior and inferior part of the os calcis; and anteriorly, in part to the tuberosity on the inferior surface of the cuboid bone, and also to the extremities of the metatarsal bones of the little toe and toe next to it. The *deep ligament* has the same attachment to the os calcis and the os cuboides as the preceding ligament, but is above it, and separated from it by a layer of fat.

Articulation between the os naviculare and os cuboides.— These two bones are connected together by two strong ligaments; one being situated on the dorsal region of the foot, and the other on the plantar. The *dorsal ligament* is of a square shape: its fibres take a transverse course from the navicular to the cuboid bone. The *plantar ligament* is composed of stronger fibres, and passes from the inferior and external parts of the navicular to the cuboid bone.

Articulation of the cuboid with the external cuneiform bone.—These two bones present articular surfaces, which are in contact, and are covered by synovial membrane; they are maintained more firmly in their situations by a *dorsal* and a *plantar ligament,* which pass from the superior and inferior surfaces of one bone to the other, covering the synovial capsule.

Articulation of the navicular with the cuneiform bones.— The anterior face of the navicular bone presents three surfaces for the junction of the three cuneiform bones, which are all covered with cartilage and synovial membrane. Three dorsal and three plantar ligaments also enter into the formation of this union. The *dorsal ligaments* pass from the superior and anterior surface of the navicular, to be attached to each of the cuneiform bones. The *plantar ligaments* take precisely the same course, but are situated in the sole of the foot.

Articulation of the cuneiform bones.—The cuneiform bones are attached to each other at their sides, each presenting an articular surface, which is covered by synovial membrane, and strengthened by three superior and three inferior ligaments.

The *superior ligaments* pass transversely from one bone to the other, forming a species of interosseous ligament. The *inferior ligaments* are precisely similar in their course, but are situated in the plantar region of the foot.

Articulation of the tarsus and metatarsus.—The three first bones of the metatarsus are articulated with the cuneiform bones; and the two last, or outer ones, with the cuboid. Their articular surfaces are covered with cartilage and synovial membrane, and are further united by dorsal and plantar ligaments.

The *dorsal ligaments* are composed of thick, short, parallel fibres, three of which pass from the superior part of the cuneiform bones, to be attached to the extremities of the metatarsal bones; and the outer ones pass in the same manner, from the superior surface of the cuboid bone, to the two outer metatarsal bones. The *plantar ligaments* are also five in number, and are disposed precisely in the same manner.

Articulation of the metatarsus.—All the bones of the metatarsus, excepting the first, are in contact with each other at their superior extremities, and present small articular surfaces, which are covered with synovial membrane, and maintained in their respective positions by *dorsal* and *plantar ligaments,* of which there are three on each region, passing transversely from one bone to the other, excepting from the first to the second.

The *interosseous ligaments* are also situated between the metatarsal bones, and serve to strengthen the articulation of these bones, and to give origin to the interossei muscles.

Transverse ligament.—The anterior extremities of the metatarsal bones are united by this ligament, which passes from the inferior extremity of one bone to the other, precisely in the same manner as in the metacarpus.

Articulation of the metatarsus and phalanges.—The superior extremities of the phalanges are articulated with the heads of the metatarsus; and they are connected by ligaments similar to those which form the junction between the phalanges and metacarpus.

The *articulation of the phalanges of the toes* is so precisely analogous to that of the fingers, as to render its further description quite useless.

The *motions* between the bones of the tarsus are but very slight; there are, however, two very important joints, which cross the tarsus in a direct line; the inner one is formed by the astragalus and navicular bones, and the outer one by the os calcis and the cuboid. Slight lateral motion is allowed between these bones.

Practical Remarks.

Dislocation of the Bones of the Tarsus.

Their motions being limited, and their bonds of union firm and strong, luxation is of rather rare occurrence, and can only be produced by great violence; under which circumstance, however, the astragalus may be separated from the os calcis, and the os calcis and astragalus may be luxated from the cuboid and navicular bones. The internal cuneiform bone is also liable to dislocation.

The other bones of the tarsus and metatarsus are too strongly connected to admit of separation, unless, indeed, it be attended with total destruction of the foot.

The phalanges of the toes are so short, as to render their displacement an improbable accident; excepting that of the first bone of the great toe from the metatarsal bone, which not unfrequently occurs, but is easily reduced.

LECTURES ON ANATOMY.

PART III.

THE SKELETON IN GENERAL.

LECTURE XI.

THE SKELETON.

By the skeleton is meant the assemblage of all the bones of an animal, united in their natural situation, either by means of their own ligaments, or by some foreign substance: the former being called a natural, the latter an artificial skeleton.

The skeleton of the human subject constitutes a symmetrical figure, both as regards its form and dimensions, according to which, the figure and proportions of the whole body are in a great measure determined. We find that the body may be divided, by an imaginary middle line, into two distinct symmetrical halves, producing thus an evident lateral correspondence; and in no system is this more obvious than in the osseous, although, indeed, the same principle applies to the general contour of the body. But so perfect is the division in the osseous system, that even the azygos bones are so centrically situated, as to admit of a corresponding division by an imaginary mezian line.

The skeleton is divided into the *head, trunk,* and *extremities.* The trunk, which constitutes the most considerable of these divisions, is formed of a middle line—the vertebral column, which must be considered as the most important part of the skeleton, forming, in fact, the great bond of union to all the rest of the bones. Its superior extremity is greatly developed and expanded, constituting the skull; while the rest of its extent belongs to the trunk, composing, in part, the neck, thorax, and abdomen.

The head and trunk present two great cavities; the superior and posterior one, formed by the bones of the cranium and vertebral canal, lodges the brain and the whole of the central portion of the nervous system; the other is anterior and inferior, is called the thorax, and lodges the central organs of respiration and circulation. Other cavities are to be found in this part of the skeleton, principally formed by the bones of the face, and serve for the reception of the organs of the senses.

The extremities are provided with many and various articulations, admitting of a great variety of motion; and are, indeed, in every way admirably adapted to the purposes for which they are designed. On examining the circumstances in which the superior and inferior extremities resemble each other, we find an increase in the number of bones towards their distal extremities, whilst their mobility diminishes; excepting, however, the comparative greater degree of motion in the articulations of the phalanges of the fingers and toes, than is admitted between the bones of the carpus and tarsus.

The upper and lower extremities further resemble each other, in the number of parts into which each may be divided, and in a corresponding form and number of their bones. Thus the most cursory observation must shew a considerable analogy between the scapula and the clavicle of the upper extremity, and the ossa innominata of the lower; the humerus corresponding very obviously to the femur, the radius and ulna to the tibia and fibula, and the hand to the foot: but yet there are many points of dissimilarity worthy attention, as tending to render them subservient to the difference in the functions they have to perform. The upper extremities are principally intended for very extensive motion, having but a slight comparative degree of weight to support, when compared to the lower. We therefore find the former most perfectly adapted to every variety and extent of motion, being but loosely connected with the trunk; while the latter are much more firmly articulated, and are in every way calculated to sustain the superincumbent weight of the body.

The relative, as well as the absolute dimensions of the skeleton, change much with the age of the individual. Thus, the proportion of the head to the rest of the trunk and the extremities, progressively diminishes from the earliest periods until adult age; for in the earlier periods of uterine gestation, even in the second month after conception, the head forms a half of the whole length of the body; a fourth part at birth, about a fifth at the third year; and it amounts only to the eighth part of the whole, when the full growth is accomplished.

In early life the face is small in proportion to the cranium, the thorax in proportion to the pelvis, and the extremities in proportion to the trunk. The different sexes present also manifest distinctions in their skeletons: thus it is found that the skeleton of the female is more delicate and smaller than that of the male, whether we consider it as a whole, or the bones individually. The thorax of the female skeleton is shorter, smaller, but more moveable; the pelvis, on the contrary, is larger, especially in its lateral dimensions; and the lumbar regions are infinitely elongated. It may be said, indeed, if a minute comparative view be taken, that not only all the regions of the body, but that almost all the bones present some special differences in the skeletons of the two sexes.

The different races of mankind present also great variety in their skeletons; some of these varieties are, however, attributable to the effects produced by artificial contrivances; as, for instance, the flattened head of the Caribbee, and the distorted foot of the Chinese female. But all varieties of form, which distinguish different races, are not to be explained by the habits alluded to; for a natural difference seems to exist in regard to the form and the dimensions of the cranium, and its proportions to the face: also in the proportion of the length of the extremities: in many of the negro race, the upper extremities are large in proportion to the trunk; and the fore arm and the foot are large in proportion to the arm and leg. That there are original national varieties of form, is proved by the inspection of the fœtus, in which distinguishing peculiarities already appear.

But not only is there to be found varieties in the form and proportions of the parts of the skeleton, at different periods of life of the different sexes, or in the skeletons of the different races of mankind, but also variations occur in the dimensions, configuration, and symmetry, in the skeletons of individuals of the same age, sex, and nation. Thus, for instance, the skeleton of a full grown European measures about five feet six inches in the male, and about five feet one in the female; this, however, is subject to a great variety, from such eauses as prevent the uniform developement and growth of the body; for we find the skeleton of a dwarf may measure only the half of the normal size, whilst that of the giant may surpass it by half, but rarely or never more than this. Some skeletons offer similar variations in the proportions between the trunk and the extremities, or between the extremities themselves, necessarily owing to variations in the length of the bones: they also sometimes differ in their configuration and symmetry.

The superiority in the developement of the bones of the right over the left side of the body, is often very decided; and there can be no doubt of its being produced by the more frequent application of their use.

Considering the number and the importance of the diseases which have their origin and seat in the various parts composing the skeleton, and which come especially under the practice of the surgeon, it would be almost a dereliction of duty on the part of a lecturer on anatomy, to an audience of intended surgeons, were he to dismiss his lecture on the skeleton of the human subject, without offering at least a few general hints as to the configuration and relative position of all its principle parts, in order to illustrate, by so doing, as well their admirable adaptation to the performance of their respective functions, as the most rational and judicious means to be pursued in repairing the injuries to which they are liable, on rational and anatomical principles.

And first, if we turn our attention to the cranium, or skull, and consider that it lodges the brain—a substance in its nature so tender and susceptible of injury, that even the slightest local pressure is often sufficient to disturb its function, and which consequently require some very solid covering to protect it—we shall find that it is constructed like an architectural vault, by which it is best able to counteract pressure, and to resist the influence of violence. We further find, as a means of protection to the important organ contained within the skull, that the arch formed by the two parietal bones is not perfectly circular, but that there is a projection at the centre of each, and that they are thicker and more convex at this part, by which these two bones afford, according to the principle of arches, an important protection to the temporal as well as to the sphenoid bone, in cases of violent concussion. It may also be observed, that all those parts of the skull which are most exposed to injury from external violence, are the most strong, from their greater convexity and thickness. But the *sutures* also give great security to the arch of the cranium, which are not only well adapted, by their dove-tailing construction, to hold each bone in its natural situation, but at the same time that they give strength to the whole apparatus, they serve to obviate the effects of concussion upon the brain.

During the early period of life, we find the cranium, as at birth, remarkably yielding and elastic; and hence it is, that the many falls and accidents incident to that period, occur for the most part with impunity; and again, if we examine the texture of the cranium in the adult, we find that it consists of two layers or tables, with a soft diploe between them: the outer table being very tough, is well calculated to resist such blows as might injure the brain by concussion; while the inner layer is hard and brittle, well calculated to resist any thing penetrating from without.

Regarding the developement of the cranium, not only is it soft and yielding at birth, but the sutures at this period, as well as a portion of the bones which enter into their formation, are in a state of cartilage; and hence it is that during parturition, the bones of the skull overlap at their edges, and thus diminish the size of the head. During childhood, as has already been said, the skull is elastic, and but little liable, therefore, to sustain injury from concussion: and during youth, up to the period of manhood, we find the periphery of the skull in parts thickened in proportion to the rest, the sutures perfected, the diploe developed, and every means employed to protect the brain, at that period of life when all the functions are most powerful and active: and lastly, in advanced age, all these apparent provisions against injury actually disappear; and the slow, cautious step of age, points out how ill fitted the bones of the skull now are to resist the ill effects of concussion upon the brain.

Having said thus much on the general structure, configuration, and provisions against injury of the skull, I shall conclude this part of my subject by briefly adverting to the varieties observed in the skulls of the different races of mankind.

Although in distinguishing the varieties of the human race, there are many points of the organization which claim attention, the peculiarities in the form of the cranium are the most striking and important, and it is on them that Blumenbach has principally founded his five grand divisions of the human race.

First.—In the *Caucasian* or *European* variety, the head is of the most symmetrical shape, often almost round; the forehead is of moderate extent, but full and not retreating; the face bears the smaller proportion to the rest of the head, it is oval and straight; the nose narrow and aquiline; the cheek bones rather narrow, without any projection, but having a direction downwards from the malar process of the frontal bone; the alveolar edge is rounded, and the front teeth of each jaw are placed perpendicularly; the chin is full, round, and somewhat prominent.

Second.—In the *Mongolian* the head is almost square; the forehead broad and flat; the proportion of the cranium to the face nearly one tenth less than in the European; the face broad and flattened; the cheek bones projecting outwards; the nasal bones, and the space between the eyebrows, nearly the same horizontal plain with the cheek bones; the space between the eyes very broad.

Third.—The *American* variety, like the Mongolian, is characterized by the considerable breadth of the cranium; the forehead is somewhat retreating; the cheek bones are large and prominent, but are rounded, instead of being angular like those of the Mongolian; the nasal bones are flattened, but more prominent than in the Mongolian; the orbits are remarkably deep and large; the nasal cavities are likewise large; the occiput is said to be somewhat flat, and the protuberances which mark the seat of the cerebellum, not very prominent. The skulls of Americans are light; and, as it would appear from a circumstance related by Azzara, and quoted by Dr. Pritchard, they more rapidly decompose after interment than the skulls of Europeans.

Fourth.—The *Æthiopian* head is compressed and narrow; the forehead is very convex; the face bears the largest proportion to the cranium; the superfices of the face, relatively to that of the cranium, being one eighth larger than in the European; the cheek bones and jaws project forwards; the alveolar edge is long, narrow, and elliptical; the front teeth of the upper jaw are turned obliquely forwards; the lower jaw is strong and very large; but the chin is retracted. The whole skull is thick and heavy.

Fifth.—The character of the *Malay* head approaches more nearly to the laterally compressed form of the Æthiopian, than to the breadth of the Mongolian; but the cranium bears a larger proportion to the face: the summit of the head is narrow; the forehead is somewhat arched, and frequently capacious; the vertex elevated, and the prominence of the parietal bones often strongly marked; the cheek bones not prominent, but broader than in the Æthiopian; the lower jaw rather prominent. Several skulls in the museum at Guy's Hospital, belonging to this race, are in good proportions; but there is in all a disposition to preponderance of the posterior part.

Pritchard makes but three varieties of form in the head :—

Narrow.—Æthiopian and Malay.

Intermediate.—European, or Caucasian.

Broad.—Mongolian and American.

Individuals in each of these races may, however, more or less, approach to one of the others ; and it therefore requires strict investigation, and a combination of the distinguishing marks, to enable the craniologist correctly to class them.

In some nations the form of the head is artificially modified; this is more particularly remarkable amongst the Æthiopians and Americans. Humbolt has remarked, that these artificial forms are the exaggerations of such as belong to their particular race : thus the North American Indian, whose forehead naturally retreats, pushes it backwards to a preposterous extent, by means of pressure.

In consequence of the foramen magnum being placed much more anteriorly in man than in other animals, some physiologists have attempted to classify the different races of mankind by its relative position ; and even in the human race, the form and position of this aperture is said not to be uniform, but has been considered to be larger, and placed more posteriorly in the Æthiopian than in any of the other races : yet Soemuxring, who has paid great attention to this subject, admits this is a questionable point. In the North American Indians, near the copper-mine river, who are remarkable for the before-mentioned depression of the forehead, the foramen magnum is found placed forwards—a fact which, if any doubt could exist respecting the use of artificial means in modifying the head, would strongly tend to remove it.

The *spine*, or *vertebral column*, serves three important purposes in the animal economy. It forms the great bond of union between all the parts composing the skeleton ; it lodges and protects the spinal marrow, and supports the head, which, indeed, according to some anatomists, has been considered a mere assemblage and modification of vertebræ. When we examine the mechanism of this column, we find it well adapted to the functions it has to perform, as it unites in itself the three different physical properties of *elasticity, flexibility,* and *strength;* thus possessing those qualities which render it best calculated to support weight, and to defend its important contents.

The great *elasticity* of the spine is owing to a soft, elastic, intervertebral substance, which is found between each two of the twenty-four vertebræ. But it is not the elasticity alone of this substance, which so admirably adapts it to the performance of its office, but also a gelatinous, almost fluid, central structure, which, being but little compressible during the erect position of the body, does not yield in the same degree as the circumference of this fibro-cartilaginous tissue, and thereby admits of the twisting of the spine as if on a pivot.

The form of the spine, which when viewed laterally resembles an italic *S*, also offers great advantages, by being able to yield in the direction of its curves, and thus admit the operation of its elasticity without a jerk, so that no jar or concussion is communicated to the brain during the more violent motions of the body.

The curved form of the spine is also essentially serviceable: in the first place, from the manner in which it is articulated with the occiput, posteriorly to the centre of gravity of the skull; for if the spine proceeded in a straight direction towards the pelvis, it would have to bear the weight under great disadvantages; but by the curve the cervical portion of the spine takes forward, it is brought in the axis of the weight, and thus diminishes the necessity for constant muscular action to keep the head erect; whilst this position of the cervical vertebræ is further useful from inclination forwards, in sustaining the pharynx and larynx. In the next place, the dorsal vertebræ curve backwards, so as to enlarge the posterior dimensions of the thorax: the full extent of the convexity of this part of the spine backwards, is brought to a line perpendicular to the attachment of the atlas with the occiput. From thence the lower dorsal vertebræ pass slightly forwards and downwards to be connected with the lumbar, the upper of which form a convexity forwards, to such a degree as to be on a line perpendicular to the centre of gravity; from thence they pass backwards to a considerable extent, that the last lumbar vertebra may be articulated with the sacrum, so as to diminish the shock that would otherwise be communicated to the spine, in a direction perpendicular to the skull.

The *flexibility* of the spine is secured by the column being composed of twenty-four pieces, which are connected with each other by moveable articulations; and although there is but a slight degree of motion permitted between any two of these bones, yet the combination of the motions of all amount to an extent sufficient to produce necessary adjustments of the body.

The *strength* of the spinal column is secured by each vertebra consisting of a double arch of bone, rendering it thereby well adapted to counteract external violence, and forming at the same time a cavity for the spinal marrow. The size of the vertebræ increases from above to below, in a proportion equal to the accumulation of weight they have to support as they descend towards the pelvis. The great strength of the entire column is evinced by the weight man is able to bear upon his head, or upon his back.

The spine of the human subject rests on the sacrum, one of the bones of the pelvis, at an angle which has been already noticed as highly beneficial in preventing concussion; but this is not the only provision which nature has made against injury to the brain and spinal marrow; for the sacrum is so joined to the other bones of the pelvis, by fibro-cartilaginous tissue and ligaments, that it may be rather said to hang to them in slings than to form any true joint; and hence it is that violence inflicted on the pelvis can only in a comparatively slight degree be communicated to the spine.

The chest, or thorax, which is composed of the twelve dorsal vertebræ behind, the twelve ribs on either side, and the sternum in front, forms a conical cavity for the lodgement of the organs of respiration and circulation. These bones are so articulated, that they not only serve to protect these organs, but are enabled, in consequence of the mode in which the ribs are connected with the vertebræ and sternum, to allow of a freedom of motion—such a motion as shall not interfere with the flexibility of the spine, and at the same time admit of a constant and uniform dilatation and contraction of the chest in the act of respiration.

It will be perceived that the ribs and sternum, at least, present those physiological characters assigned to flat bones in general; their form and arrangement being such as to contribute to the protection of the viscera contained in the cavities which they form, as well as to assist in the performance of the function of the viscera themselves. The elasticity of the cartilages forming the anterior portion of the ribs, tends also to facilitate their motions in the act of respiration, whilst, at the same time, it is calculated to obviate the effects of violence inflicted on the chest; and hence it is too, that when from age this elasticity is impaired or destroyed, hurried and laborious respiration becomes distressing to the individual, whilst violence is more likely to produce fracture.

The upper extremities have already been mentioned, as enjoying a great degree of motion; and if we examine, we shall find that each joint possesses an organization admirably adapting it to the offices nature has destined it to perform; and as the motions of the extremity as a whole are performed by the shoulder-joint, as we should naturally expect, we shall find the means employed to procure its extensive and various motions the most perfect. In the first place, the scapula, which forms the shallow articular depression for the head of the humerus, is connected with the trunk by numerous muscles, which are capable of giving motion to it in a greater or less degree in every direction, so that all the motions of the shoulder are increased by those of the scapula. The articular cavity being shallow, and the head of the humerus forming the part of a segment of a large circle, as well as the length of the capsular ligament, also fits this articulation for extensive mobility. These circumstances all rather tend to increase the extent of motion of the shoulder-joint, than to give it strength; but yet the easy mobility of the whole apparatus prevents its readily receiving injury from external violence. The scapula is further to be considered as useful, both from its arched form and situation, in defending posteriorly the organs of the thorax from injury. The os humeri is not perfectly cylindrical, but has ridges which serve to give strength to the bone, and attachment to its muscles. In all classes of animals the humerus is single, and it may be said to be shorter accordingly as the metacarpus is lengthened.

The *elbow-joint* is formed of a number of eminences and depressions of bone, which are so perfectly adapted to each other, as to prevent any motion but in the direction of flexion and extension. The humerus, ulna, and radius, all assist in forming the elbow-joint; but the radius, it is to be remembered, moves upon the humerus, for the performance of a function independent of this articulation, and which produces the pronation and supination of the hand. This joint is so strongly and firmly secured, as rarely to be dislocated without fracture.

The fore arm is composed of two bones, which are separated from each other in their middle, although they are connected at each extremity, the interspace being filled up by muscles. The radius, which is articulated with the carpus, turns upon the ulna, and carries consequently the hand with it in the motions of pronation and supination,—the former of which motions is much more frequent than the latter.

The hand, which is composed of the carpus, metacarpus, and phalanges, is continuous with the general axis of the arm. Its numerous bones and articulations admit of such a degree of motion, as to render it the most perfect prehensive organ; at the same time that it is enabled, from the quantity of elastic structure which enters into its composition, to obviate the effects of violence from concussion upon the other bones of the upper extremity. The wrist-joint, which is produced by the articulation of the upper row of the carpus with the radius and interarticular cartilage also assists in deadening the shocks which the hand may receive. The carpus forms the upper boundary of the hand; and is not only rendered infinitely strong by the number of the bones, but also by their arrangement; for they are so placed as to form an arch, the concavity of which is towards the palm, while the convexity is directed backwards, to resist violence in the direction in which it is most exposed. The metacarpus is composed of four bones, placed between the fingers and the carpus, and forms the palm of the hand, which is of a square form, but broader at its digital than at its carpal end, so that the metacarpal bones somewhat diverge inferiorly, and thus serve not only to enlarge this surface, but also to extend the range of motion of the fingers. The bones of the metacarpus are concave in the palm, and convex on the dorsum of the hand; they are separated from each other to lodge and give attachment to muscles, as well as to encrease the prehensive surface of the hand. The fingers are five in number, and enjoy both separately and collectively more motion than the other parts of the hand; and however perfect the organization of the carpus and metacarpus may be, still, without the faculty of motion, and that peculiar adaptation of parts which the fingers possess, the hand would yet have been but ill fitted for the numerous and important functions for which nature has intended it as a fit instrument to a rational being like man.

The *pelvis* at the adult period of life is composed of three large bones, the ossa innominata and the sacrum—the os coccygis is rather to be considered as an appendix to the sacrum than as a separate bone in the formation of this cavity. The bones of the pelvis are all so firmly connected, and their adjustment so perfect as to their mechanical disposition, as to be admirably constructed for the purposes of supporting the superincumbent weight of the trunk, for lodging and protecting the viscera within the cavity, and to form a fulcrum for the lower extremities to move on. These bones, in fact, form a double arch, which gives to them great additional strength, whilst the lower extremities may be considered as supporters to this arch.

The axis of the pelvis is not perpendicular to the central line of gravity, hence the viscera of the pelvis are infinitely better supported by the bones, and the whole weight of the body is thrown upon the lower extremities. The human subject, by this arrangement, is also enabled to support the erect position; while the expansion of the bones afford ample attachment for those muscles which are destined to maintain it.

In the sitting posture, the axis of the pelvis is so altered, that the central line of gravity falls upon the tuberosities of the ischia, upon which the whole weight of the body is then equipoised—a position which would have been impossible to man, had the sacrum continued in the same line with the spine; or, in other words, had the axis of the pelvis been perpendicular with the line of gravity of the body. In the descriptive anatomy of the pelvis, the cartilages and ligaments which serve to connect the bones have been noticed; which are not only destined to form the medium of connexion between them, but also to obviate the effects of concussion upon the spine and viscera which they contain.

The variation of size in the male and female pelvis has already been alluded to: the lateral proportions in the female infinitely preponderating, to allow of the increase of size of the uterus during its impregnated state.

The greater proportionable size, length, and strength of the inferior extremities of the human species, when compared with those of inferior animals, proves, with the facts already stated of the form and position of the pelvis, that man alone was intended to support himself in the erect posture.

The *thigh-bone* we find articulated with the pelvis by its head, which forms a considerable portion of a sphere, being admitted into a deep cotyloid cavity, and being further connected with this cavity by a strong interarticular ligament, rendering this articulation well fitted to bear the weight of the body. The weight is thence transmitted to the thigh-bone by its neck at an angle, which, together with the width of the pelvis, serves to separate the thigh-bones widely from each other, and thus leave sufficient space for the external organs of excretion and generation. From the point of attachment of the neck to the shaft, the thigh-bone is directed downwards with an obliquity, so as to bring its inferior extremity immediately under the pelvis towards the central line of gravity, so that the two bones of this joint approximate and form a firm base of support, as well as render progressive motion both more secure and direct. The thigh-bone is remarkable for its projections, which not only serve to strengthen the bone, but also assist the action of muscles by altering the angle of their attachment. The anterior curvature of the femur tends also to encrease its power of resistance.

The lower extremity of the os femoris is expanded into two protuberances or condyles, which form two large articulatory surfaces for the tibia, and are so separated behind as to admit the popliteal vessels and nerves between them, and thus offers them protection from injury.

From what has been said of the obliquity of the thigh-bones inwards, it is clear that the two condyles, which are intended to come in contact with the upper surface of the tibia on the same level, cannot be precisely of equal length, unless indeed the leg had a corresponding obliquity; we therefore find the internal condyle the longer of the two.

The *leg*, below the knee, is composed of two bones, which must necessarily give greater strength than the same substance in a single bone could have done: they are furnished with spines or edges, which render them better capable to resist injury. The two bones of the leg are separated from each other like the bones of the fore arm, and the interspace filled up by ligament; but they differ essentially from the bones of the fore arm, which admit of a rotatory motion upon each other, while the bones of the leg are much more firmly connected, to offer a more perfect support to the body.

The articulation of the leg with the thigh, assisted by the patella, form the *knee-joint*, which may be considered as the most complicated in the body, in consequence of the numerous and strong ligaments which surround it. It has been mentioned, that this joint, when a little bent, admits of a slight degree of rotatory motion; and this is performed by the internal condyle turning on its own axis on the inner articular face of the tibia, while the external condyle moves backward and forwards; but the rotation is allowed to a greater degree outwards than inwards, from the mode of the attachment of the crucial ligaments.

The outward twisting of the leg is of use in progressive motion, by allowing the foot to form a broader base for support; whilst, at the same time, it is favourable to the action of crossing the legs. The obliquity of the knee-joint inwards serves to encrease the elasticity of the lower extremity, and consequently to diminish the effects of concussion, by throwing the weight from the perpendicular line of the femur. It is further useful in leaping, by producing the force caused by the sudden extension of the joints acting nearer to the centre of gravity.

The *foot*, which is composed of the tarsus, metatarsus, and phalanges, forms a beautifully constructed elastic arch, sufficiently strong to support the whole weight of the body, and at the same time sufficiently pliable to prevent its sustaining injury from concussion under the most violent exertions. These ends are effected not only by the various bones of the foot forming numerous articulations, and these being furnished with elastic cartilages, but also by the foot itself forming a longitudinal arch, reaching from the posterior extremity of the os calcis to the anterior extremity of the metatarsal bones. The most convex part of this arch is situated at the upper part or dorsum of the foot, and is formed by the astragalus, which receives the weight of the body through its articulation with the tibia and fibula; so that the astragalus may be considered as the key-stone to the arch, rendered better able to bear the great pressure to which it is subjected, by resting upon a fibro-cartilaginous structure; which structure allows it to sink or rise as subjected to or relieved from pressure. A second longitudinal arch is formed from the extremity of the metatarsus to the extremity of the toes, which renders them both stronger and prehensive, and assists much in progressive motion. A third arch is formed in the sole of the foot besides the two already described, which reaches from side to side, and serves not only to assist in giving elasticity and strength, but also to protect the soft parts, which might otherwise be injured from pressure. From these remarks it must be considered that the foot possesses a considerable degree of mobility; but it also must be remembered, that it exerts this mobility only during motion; for when we are standing still in the erect posture, or when the weight of the body bears directly and perpendicularly on the astragalus, all the parts of the foot are so closely pressed together, as to render the whole an immovable and unyielding structure. The projection of the heel-bone, or os calcis, passes backwards considerably posterior to the articulation of the bones of the leg with the foot, so that in progressive motion the part of the foot which first comes to the ground shall not be placed immediately underneath, and perpendicular to the tibia and fibula; and thus the elasticity of the foot is called into action to prevent concussion and jolting. The lengthening backwards of the os calcis also affords additional power to the extensor muscles of the ancle-joint.

The *ancle-joint*, which is formed by the union of the foot with the bones of the leg, admits of motion in such directions as assists in the performance of the movable capabilities of the foot; and again, by projecting portions of bone, render the foot firmly fixed when its stability and strength are most required: for instance, in progressive motion, when the foot is pointed downwards or extended, then the astragalus is capable of lateral motion between the malleoli; so that the foot may be directed at will; while, on the contrary, when the whole of the body is thrown upon one extremity, and consequently perpendicular to the foot, the ancle-joint remains motionless, and a firm base of support is produced.

In fact, if we examine the means which are employed in the formation of the human skeleton, for the purposes and functions for which it was intended, we can but be struck with admiration and awe at the wonderful designs nature has manifested in the performance; and yet we should observe, that to provide against every possible accident and injury was not the intention of the Creator, but rather that the great prerogative of man, his judgment and his power of reason, should not only assist him in the proper applications of its various functions, but also be continually called in aid to avoid the injuries to which it is so constantly exposed. It has been ordained, indeed, that we should be the subjects of disease and decay.

END OF VOL. FIRST.

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LECTURES

ON

A N A T O M Y.

LECTURES

ON

ANATOMY:

INTERSPERSED WITH PRACTICAL REMARKS.

VOL. II.

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SURGEON OF GUY'S HOSPITAL, LECTURER ON ANATOMY,

&c. &c. &c.

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INTRODUCTION.

I have in this Volume endeavoured to follow up my original plan, of placing before my Pupils a general outline of my Lectures as delivered in the Anatomical School of Guy's Hospital.

This portion of my projected work will be found to comprise the General and Descriptive Anatomy of Muscles, Cellular Membrane, and the common Integuments; thus concluding the exterior structures of the body.

My object has been to render the subject clear to the Pupil, in the direct progress of his anatomical studies; which may have betrayed me occasionally into prolixity and tautology. I have, however, steadily kept the advantage of my plan in view; which has been to present a correct course of anatomy, combined with surgical and physiological remarks: regarding the utility of my purpose more, than the production of an elaborate or erudite performance.

London, 1830.

CONTENTS.

PAGE.

Table of the Muscles.

It is expected, that this Work will be comprised in Four Volumes. Vol. III. will contain the Anatomy, with the Physiological and Surgical Remarks, of the Interior Parts of the body. Vol. IV., the Brain, Nerves, and Organs of the Senses.

LECTURES ON ANATOMY.

PART IV.

GENERAL ANATOMY OF MUSCLES.

LECTURE XII.

GENERAL ANATOMY OF MUSCLES.

The muscular system comprehends that soft part of the body which is, in common language, termed flesh: the substance itself, from the power it possesses of contraction, has been denominated muscle from the greek μυειν, to contract. This faculty cannot be traced to any chemical or mechanical effect, but to a peculiar inherent tendency the muscular fibre has to shorten, upon the application of a stimulus, which, in ordinary circumstances, is communicated to it through the nervous system.

As this is the structure which gives motion to the solids as well as to the fluids, and indeed regulates the locomotive power of the whole body, it forms, as might be supposed from the variety of functions in which it so actively assists, a very considerable part of the corporeal substance, adding much to the weight and marking the general outline and contour of the human frame; for although the skeleton bears so strong a resemblance to the figure of the body, yet the eye of the anatomist cannot dwell for a moment on the articulated bones without seeing the necessity for other structures to determine the rounded exterior form of the human subject.

I shall now proceed to describe the general characteristics and physical properties of this system, that it may at once be distinguished from the other systems and tissues which enter into the composition of the human body.

The muscular system may at once be recognised and distinguished from the other parts of the organismus, being composed of a number of fleshy fasciculi, which are soft, moist, slightly elastic and semi-transparent; formed of longitudinal and parallel fibres, which are irritable and contractile;

and, in warm-blooded animals, of a red colour. But upon a more minute examination as the muscle lies in masses in a relative position, or investigating it more closely when separated from the body, it is found to be composed, not of one homogenious structure, but of three distinct tissues:—fleshy fasciculi, tendinous fibres, and cellular membrane; each of which structures is essential to the function of the muscular system, although to one only of them is attributable that contractile power which marks vital property; and to these may be added,—arteries, veins, nerves, and absorbents. The *fleshy fibres* of the muscles are disposed in fasciculi, which are placed by the side of each other, and never intersect: these fasciculi are separable into fibres, these again into smaller fibrillæ, and even these may be subdivided until you expose what has been termed the ultimate fibre, which is so small as only to be visible by the aid of a microscope, but which some believe to be of itself only indivisible for the want of delicacy of manipulation and niceness of instruments. There are physiologists who maintain that the primitive fibres, as they have been called, are of considerable length, and extend, in many muscles, from their tendinous origin to their tendinous insertion; this opinion, however, is not generally believed; on the contrary, it is thought that each of these lengthened fasciculi is made up of a number of the ultimate fibres connected with each other at their extremities through the medium of the cellular membrane.

The difficulty of ascertaining the true structure and organization of the ultimate fibre of a muscle may be supposed, when it is estimated as not surpassing one two-thousandth part of an inch in diameter; and therefore, on this point, a great difference of opinion exists: some affirming that it is solid, and consists of a substance resembling the fibrine of the blood, enclosed in a reticulated membrane: others, that it is a hollow cylinder: again, that they are composed of rounded corpuscles, placed like a series of pearls, connected by cellular tissue: but it seems too true, that their real structure has not been ascertained; although, from the different opinions I have read, and from my own observations and inspection of fresh and boiled muscular fibre, I feel disposed to believe, with Meckel, that the muscles are solid, and probably composed of the fibrine of the bood, modified by the vessels which are destined to deposit this peculiar structure. The red colour of the muscular fibres in vertebral animals is generally attributed to the blood; because, in exposing muscle to a running stream, the colour disappears as the blood is washed away: but the circumstance of their paleness in the amphibia, and also their perfect whiteness in red-blooded worms, proves that their colour depends upon something besides the blood. It has been supposed by some to result from the aromatic constituent of the muscle, termed osmazome.

The *cellular membrane* of the muscles is a soft spongy tissue, which not only affords them a general covering of greater or less density, but envelopes every fasciculus, and, ultimately, every fibre, and also fills up the interstices between its separate divisions; forming here, as in every part of the body, the great medium of connexion as well as separation: nor is this the only use it affords to the muscular system, for its cells secrete an albuminous fluid, which, together with a considerable quantity of fat, tend to lubricate their surfaces, and necessarily facilitate their motions.

An *adipose membrane* is also found surrounding the muscles: at certain periods of life it only covers them externally, being between them and the skin; while, at later periods, it is found between the fasciculi which compose the muscle; and, in old age, between the very fibres themselves.

The *tendinous fibres*, which are connected with those of the muscles, appertain chiefly to the external or locomotive muscles, and form the medium of their connexion to the bones: these fibres are easily distinguishable from the fleshy fibres, being of a white silvery lustre, and not possessing any contractile power: they belong to the fibrous system of the body; and their organization, physical properties, and general characters will be described when treating particularly of that tissue. Their use to the muscular fibre is, to concentrate the force of its contractile power, and to diminish the surface for their insertion into bone, which must necessarily have been much more extensive had the fleshy fibres themselves been connected to the osseous system; and they further regulate and modify the force and direction of their action. These tendinous fibres are not always for the purpose of forming the points of attachment of muscles; they are sometimes found in the very substance of the muscles; in fact, they are subject to many varieties of situation in the muscular system, which will be pointed out when describing in detail the classification of the muscles. The strength of the tendons seems to depend rather upon the peculiar conformation of its tissue than upon any vital principle, which is evinced by its retaining all its physical powers even after death

Blood-vessels are found in great abundance in all the muscles, but not in all alike, as will be hereafter more particularly mentioned.

The *arteries* are sufficiently large to be demonstrated, so that their course may be traced; and their larger trunks are found entering towards the centre of a muscle, where they immediately divide into smaller ramifications, which are equally destined to supply the true fleshy fibre, the tendinous and the investing cellular membrane. Those which supply the fleshy fibres convey the red particles of the blood; from which circumstance, as well as from their size, they may be observed to divide into two sets of ramifications; one distributed to the superficial, while the other, including the greater number, supplies the deeper fibres; and it is supposed that the ultimate ramifications of these vessels are as numerous as the ultimate fibres which constitute the muscle. The arteries of this system increase in size in proportion to the degree of action to which the muscle is exposed, and are also materially influenced in this respect by the health and age of the subject; hence the redness of the wings of birds of flight, and the comparative whiteness of the muscles of their legs, which proves that the redness of the muscular system is derived, in -

some measure at least, from the blood. The arteries which supply the tendinous fibres of the muscles are smaller than those which supply the fleshy fibres, and are destined to convey only the transparent parts of the blood, so that they are with difficulty demonstrated; while the vessels which supply the cellular membrane, although very small, do convey some slight colouring matter, which proves that the different ramifications of the same trunk are capable, not only of being distributed to different tissues, but also of yielding only such parts of the blood to them as can be assimilated, and assume the character of that structure of which they are destined to form a part. It is found that the larger trunks of arteries, as they pass through the muscular system to distant parts, are deeply situated, and are placed in such circumstances as to be protected from external injury.

The *veins* which return that portion of the blood from the muscular system which is not employed for their growth, development, and function, are distributed in two sets; the one being situated in the interior of muscles, accompanying the arteries, while the other is observed running upon the surface of the muscles: the object of this appears to be, that, during the action and consequent contraction of a muscle, the flow of blood through the veins towards the heart should not be impeded; hence the phenomenon of the superficial veins becoming distended with blood when the muscles of the arm are put into a state of contraction. The veins have a greater capacity than the arteries: they commence, by the minutest ramification, from the ultimate fibre of the muscle, into which an equally small ramification of an artery had terminated; and then, forming frequent anastomoses in the surrounding cellular membrane, produce the larger superficial branches, and take their course towards the heart. The veins of the muscular system have been supposed by Bichat not to be supplied with so many valves as the veins of the other structures; but he seems to infer it only from the supposition that they do not require them in consequence of the support they derive from the muscles themselves, which form a substitute for them by taking off the pressure of the column of blood from their coats.

The *absorbents* of muscles, neither in structure nor in distribution, offer any thing peculiar; they are rather supposed than proved to arise by a minute ramification from the ultimate fibre, and then proceeding with the blood vessels to the surface of the muscle, they may be demonstrated taking their course in the interstitial spaces of the fasciculi with the veins, proceeding with them until they enter the gland, into which they penetrate before they reach the thoracic duct. It may be presumed, that this system is proportionably as freely distributed to the muscles as to the blood-vessels and nerves, which are so abundant.

The *nerves* of the muscular system are both numerous and large, more especially those nerves which supply the external muscles; while the muscles internally seated receive fewer filaments, and from a different source. Again, there are intermediate muscles which receive their nerves from both sources, and have properties peculiar to each class: but this grand division of the muscular system will be described in detail, after the general attributes of muscle have been treated. Thus the muscles derive their nerves from three sources:—the brain, the spinal marrow, and the sympathetic; and from these they proceed as nervous cords accompanying the blood-vessels, more particularly the arteries; they form frequent plexuses from which several muscles are supplied, probably for the purpose of producing a reciprocal and simultaneous action; but this will be further investigated when speaking of the properties of the muscular fibre. The manner in which the filaments of these nervous cords are distributed to the muscles is difficult to comprehend, from the extreme minuteness of their division, which has led to a variety of opinions on the subject. It is considered by some, that they subdivide into as many filaments as there are fibres of the muscles to which they are distributed; so that each ultimate fibre receives an artery and a filament of the nerve, and sends off from it a vein and an absorbent: others are of opinion, that the nerves do not enter the minutest parts of a muscle as a cord, but that the neurilema ceases, and that the soft medullary part of the nerve alone enters into its composition. The cellular membrane is supposed by some physiologists capable of becoming a medium of communication between the nerve and the muscular fibre, without the direct entrance of the nerve itself into the muscle: and, again, there are authors who believe that the nerves, in whichever of these modes they may reach the muscle, are not distributed to all of its fibres, but only to a few; which, being stimulated to contract from the influence of the nerve, produce by their action the stimulus of contraction to the rest of the fibres in the direct line of continuity, so that only a part of a muscle need be in a state of contraction. Reil had yet another hypothesis:—that a nerve was capable of extending its influence to some distance from its termination, by what he termed its "*nervous atmosphere*." That there should be so many opinions proves only the difficulty of arriving at precise conclusions; a difficulty arising principally from the minuteness of the structure upon which the vital properties of the muscular system depend. That it is the nerves, however, which induce the contractile state of muscle, is negatively proved by the experiment of dividing the trunk of a nerve in its passage to a muscle, when its voluntary power of contraction ceases, although it may yet be stimulated to action by mechanical or chemical agents. It may be observed, that the greatest part of the cerebral system of nerves are distributed to the muscles, and that they bear generally a proportionable size to the muscle upon which they ramify. If a muscle is destined to assist in the performance of more than one function, it is supplied with nerves from more than one source; a circumstance beautifully illustrated by the physiological and philosophical discoveries of Mr. C. Bell, to whose scientific attainments too high a tribute of respect cannot be paid.

Chemical Analysis.

The muscles have been already described as having several structures and systems entering into their composition; we accordingly find, that they afford various substances when exposed to chemical analysis; but it may be justly said that there is but one constituent which forms the distinguishing characteristic of this system,—the fleshy fibre, which is proved to be very analagous to the fibrine of blood. The red colour which the muscular fibre possesses is not peculiar to it; for by cutting the fibre into very minute pieces, the colour may be completely extracted. Berzelius, from the result of his experiments, has given the following analysis of the muscular system; but, before the precise substances are mentioned, it may be well perhaps to inform the student, that all animal matter differs from vegetable, in having an additional elementary constituent, namely, nitrogen; carbon, hydrogen, and oxygen, alone forming the elementary bases of vegetable matter.

An hundred parts of dried muscle, according to Pfaff, as quoted by Meckel, consisted of the following proportions of the elements of animal matter:—

Carbon	48	30
Hydrogen	10	64
Nitrogen	15	92
Oxygen	17	64
	92	50
Fixed Salts	7	50
	100	00

The other substances which compose muscle, are divided by Berzelius into those which are solid, and those which are fluid.

Solids.

Muscular fibres, vessels and nerves	15	8
Fibres and cellular membrane dissolved by decoction	1	9
	17	7

Fluids.

Muriate and lactate of soda . .	1	80
Coagulated albumen and fibrine .	2	20
Phosphate of soda	0	90
Extractive, soluble in water only .	0	15
Phosphate of lime with albumen .	0	08
Water and loss	77	17
	100	00

Berzelius also speaks of the presence of a free acid, which he terms lactyne. Besides these constituents is found a peculiar extractive matter of a brown colour, of a pungent taste, and of an aromatic odour, which has been named osmazome by M. Thenart, and by him is supposed to be the principal source of the flavour of the flesh of animals.

The stronger acids and caustic alkalies act freely upon muscle, and will ultimately dissolve it; during this action a considerable quantity of gas is evolved; and if nitric acid be used, nitrogen is disengaged: the same phenomenon occurs if nitric acid be poured upon other animal substances, but not to the same extent as where muscular fibre is exposed to its influence. If muscle be exposed for a length of time to a slow running stream of water, it becomes converted into a substance of an unctuous quality very much resembling spermaceti, and which is called adipocire; this process is quickened if muscle be subjected to the action of diluted nitric acid. The spontaneous conversion of the bodies of those buried in a certain part of Paris, is a peculiar instance of this chemical change: there is also another instance of it on record in this metropolis in two bodies, which had been buried many years in the church-yard of St. Saviour, Southwark, which were found completely converted into this substance.

Properties of Muscle.

The muscular fibre, in common with every other modification of matter, possesses certain properties connected with its form, texture and external character; but superadded to these it also displays powers which distinguish it as forming a considerable part of a *living* organized body: hence it is, that the properties of muscle have been rightly divided by all physiologists into physical and vital.

The *physical properties* of the muscular fibre depend upon its form, structure, and general external characters; and may be considered to be flexibility, extensibility, adhesiveness, and elasticity. These properties, however, are with considerable difficulty appreciated, in consequence of the various structures which surround and connect them; a difficulty, too, not a little enhanced in many instances by the influence of divers circumstances affecting the muscles, either before or subsequent to death. Subjected to the action of cold, they lose much of their red colour as well as a large proportion of their weight, becoming hard, of a brown colour, and semitransparent; changes greatly accelerated by exposing them to the action of a current of dry air. By maceration, a muscle undergoes several changes, which vary with the kind of fluid to which it is exposed: thus, alcohol and diluted acids cause it to soften and swell; a solution of corrosive sublimate, or alum, causes its fibres to separate by the shrinking of the cellular membrane surrounding them, and increases the consistency of the muscular fibre itself by inducing its contraction. A solution of common salt will produce the same effect of rendering it harder; and, at the same time, will increase the redness of its colour. If muscle be exposed to the process of boiling for a considerable time, its fibres become entirely colourless, are easily separable, and, if analysed, are found to resemble the fibrine of the blood, like it, becoming fragile when cold. If exposed to a strong dry heat, so as to be calcined, it is said by Berzelius to leave a saline matter amounting to one-twentieth part of its weight. The physical elasticity of the muscular fibre,—which is mentioned by some physiologists, and which is contended for in consequence of the apparent power a muscle has to assume its natural size after it has been stretched by some mechanical pressure, as after ascites or parturition,—is doubtful; it being a question whether this apparent physical elasticity belongs to muscle, or to the surrounding tissues; for we find after death, at least, that it loses this power upon the separation of its cellular coverings, when it is very readily torn.

Vital properties are those by which the functions of the muscular system are produced. During life, the muscles are observed to possess and to exercise a power which is termed contractility; the capacity for which is designated irritability. By contractility is meant, that power by which a muscle, from the application of a stimulus, is capable of shortening itself; and it is in consequence of this inherent power, that all their actions are performed. A muscle, when in a state of contraction, becomes harder, thicker, broader, proportionably shorter, and transversely wrinkled, and their fibres are observed to manifest a trembling or oscillating motion, which is owing to their alternately contracting and relaxing; and they are further found by experiment to have acquired considerable strength, which seems obvious from the fact, that muscles are less capable of resisting injury from external violence during their passive or relaxed state. Such is the state, as usually described, of a muscle when in action; but there is reason for entertaining some doubts as to the accuracy of the account given. Is it, for instance, certain, that the muscular fibres of a muscle are of necessity shortened during contraction; or, may it not be, that the muscle is only thrown into the form of a bow, as its two extremities are made to approach each other? For if we attempt to raise a weight too great for our muscular power, the muscles are put into the greatest possible state of action, and yet no shortening can occur; so that it may be said, that the shortening depends upon the degree of stimulus being greater than that of the resistance. The apparent thickness and increase of hardness in a contracted muscle, may also be attributed to its change of place by bowing forwards when in action. The widening of a muscle is also doubtful, while it is in a state of contraction; for that appearance, and also the wrinkled state, seems to be produced, rather by those fibres which are not contracted than those which are, as well as by the cellular membrane; so that it seems probable, that the fibres of a muscle during action, where the stimulus is capable of overcoming the resistance, produces an approximation of every fibre in action, diminishing at the same time both the length and breadth of a muscle, and, consequently, diminishing also its bulk and producing its hardness. There has, however, been much variance of opinion upon the subject of the enlargement or diminution of muscle during its contraction; and experiments have been instituted by physiologists to discover their actual state, although nothing very conclusive has ever been ascertained. Glisson seemed to conclude, from his experiments, that the muscle was actually diminished in bulk during contraction. Sir Anthony Carlisle considered that their bulk was increased, and produced therefore a rising of the fluid, into which the living arm of a man was immersed: while Sir Gilbert Blane was of opinion, that no change of bulk was evident during the contracted state of the muscular fibre; and his experiment was made by enclosing a living eel in a vessel, the neck of which was drawn out in a fine tube, when, by irritating the animal so as to produce its contraction, the fluid was found to remain perfectly stationary in the tube of the vessel: but they all agree, that the muscle becomes harder while in action; of which we have a ready proof by feeling our masseter muscle while at rest, and during the process of mastication. It is also a question as to the quantity of blood in a muscle during its state of contraction, whether or not there be less at that time than when in a state of relaxation: the latter we are led to believe, from a change of colour which is said to be observed during its action; as well as from the fact, that the blood flows more readily from the superficial veins when the muscles are made forcibly to contract. Hence it seems that less is allowed to pass into their substance: and if this be proved, it would also be an argument for the diminution of bulk in muscle during its activity. There are, however, some reasons for doubting that the quantity of blood in muscle is diminished during its contraction; for the experiment which the physiologists who are of that opinion have taken to prove it, cannot be considered as conclusive: they have examined the heart of a frog, which they describe as becoming pale during contraction; but this appearance is owing to the transparency of the ventricles, transmitting therefore a deeper red at the time they are full of blood, which has no bearing upon the question before us.

During the contraction of muscle, little or no sensation is produced in the contracting part, but only in the part pressed; this is proved by clenching the fingers, when the palm of the hand is felt, but no sensation along the muscles of the fingers: indeed it has been believed, that muscle has no sensation during its active state of contraction; and it has been alleged from the experiment, to which many people voluntarily subject themselves, of pushing pins into the calves of the legs; yet a long continued forcible action is itself a very painful sensation, as every pupil taking lessons in dancing and fencing will readily acknowledge.

While a muscle is contracting, there is said to be a continual agitation of its fibres, which has already been described as being produced by the alternate relaxation and contraction of them; and it is also said, that by examining a muscle while in action through a stethoscope, a noise may be heard; and if the little finger be pressed into the meatus auditorius, the same noise is heard, which Dr. Woollaston attributed to the motion of the muscular fibres of the arm; but some philosophers have considered it to be produced by the flow of blood through the vessels, which seems to be most probable, as the noise, if attended to, will be found to be syncronous with the pulse. The quickness with which muscular contraction is effected is very considerable, and can but excite wonder when we consider the various muscles employed in running, speaking, &c. The power exercised by the muscles when in action is enormous, so great as sometimes to break the bones to which they are attached: the force is necessarily always in proportion to the number of fibres in action. The extent of muscular contraction is generally in proportion to the length of the muscular fibres, and is increased when nothing is opposed to it, as becomes evident in cases of fractures. The extent to which muscles are said to have the power of contracting themselves, is computed by physiologists to be to a fourth of their length of those which serve for the animal functions; while the involuntary, or those of the vegetative life, contract to one third: but it is doubtful if much reliance can be placed upon this observation.

The chief and prime cause of muscular contraction, is a vital principle, which gives to the muscle that peculiar power, by which its whole economy is regulated. There is, however, a necessary condition for the muscular system to render it susceptible to the stimuli which produces its contraction; it must, in fact, be participating in the general circulation of the blood, and be connected with the centres of the nervous system; and if there be any circumstance which removes it from these influences, or in any way produces an interruption to these communications, there is always, sooner or later, a cessation of its action, Bruises, or injury to the surrounding cellular tissue of muscles, will also diminish, and sometimes deprive them of their contractile power.

Muscle in a state of relaxation is placed under precisely the reverse circumstances to those attending its state of contraction; the belly becomes soft, the bowed direction of its fibres is lost, its transverse wrinkles disappear, its extremities no longer tend to approximate, and the whole muscle is quiescent. With respect to this state of relaxation, a question arises, whether it be merely a cessation of action, or, that there is an active power necessary to restore them to their natural passive situation;

for, as there are antagonists to every muscle, an elastic substance surrounding them, and also the laws of gravity acting upon them in their quiescent state,—all these may be considered as forces producing the relaxation after the contraction of muscular fibre, which, consequently, cannot be considered as mere cessation of contraction only.

Having now spoken of the irritability of muscular fibre, which means its susceptibility to receive impressions from stimuli; we have now to describe what are the kind of stimulants which produce contraction of muscle, and through what medium they communicate the impression.

The kind of stimulants have by many physiologists been divided into *vital*, *mechanical*, and *chemical*.

Those of the first class act through the medium of the brain, and consist of the influence of the will, and such violent emotions of the mind as are termed passions; but in order that the will may operate as a stimulus to a muscle, it is necessary that there be a direct communication between the muscle and the brain by means of a nervous cord. The following facts prove this assertion:—if we will, for instance, to flex the arm, its muscles immediately contract and produce that action, so long as their nerves are connected through the medium of the spinal marrow with the brain; but if these nerves be separated from the spinal cord, although the brain has still the power to will the motion, yet its influence upon the muscles ceases, and the limb remains incapable of motion from vital stimuli, although mechanical or chemical stimuli acting upon the divided nerve will yet produce an involuntary action of the muscles: this latter phenomenon only lasts, however, for a short time after the nerve has been separated from the centre of the nervous system. The passions seem to produce an immediate effect upon all the muscles of the body, both of the voluntary and involuntary class.

Of the mechanical stimuli, their application, even from the slightest touch to the greatest degree of violence, will produce the contraction of muscle, whether it be applied to the brain, spinal marrow, nerve passing into a muscle, or to the very muscle itself. Indeed, mechanical stimulants sometimes rouse into action a distant set of muscles which seem to have no direct communication; as a crumb of bread in the glottis produces violent contraction of the muscles of expiration. The natural stimuli to the involuntary muscles seem to be of this class, as the flow of blood into the cavities of the heart, and the accumulation of the contents of the viscera produce contraction of their muscles; but this may perhaps be partly attributable to chemical agency.

The chemical stimuli, as alcohol, acid, alkalies, &c., produce an immediate action on the muscular system, and more especially on the involuntary muscles; but it is perhaps doubtful, whether they really produce it from chemical or mechanical influence. Galvanism and electricity, which produce no apparent physical change in a muscle, will yet cause its violent contraction; it is difficult, therefore, to know which class of stimulants to place them with; no change, either mechanical or chemical, can be traced: they have, therefore, by some physiologists been ranked amongst the vital stimuli, considering, perhaps, their effect as more closely allied to the natural impulse communicated to the muscular system through the brain and nerves; for the contraction of muscles, produced by high degrees of nervous affections, is very similar to the contractions produced by galvanism or electricity.

It is no less true than wonderful that particular muscles, and even particular fibres of the same organ, should be differently affected by different stimuli; thus, certain substances produce the natural action of the stomach and the bowels, while others will produce vomiting and purging; and yet no difference can be perceived in the organization or chemical properties of the fibres themselves. There seems, however, to be a contractile power in muscle which is independent of any influence from the nervous system, as indicated by the contraction of a paralysed muscle, or the involuntary action of a voluntary muscle, as in cramp and spasm: this inherent property has been termed by Haller the *vis insita,* in contradistinction to the *vis nervosa,* which enables it to receive the impressions made upon it through the nerves; the one, in fact, being voluntary, while the other is involuntary. May not the rigidity which is observed to take place in muscle immediately after death be attributable to an exertion of the vis insita? Such rigidity, however, we know is in a short time succeeded by permanent relaxation.

The volition of the mind, which acts through the medium of the nerves, produces its influence only on a certain class of muscles, which are called, therefore, the voluntary muscles. The excitement caused by the passions of the mind is also transmitted through the medium of the nerves, but is capable of extending its influence to every class of muscle; as is proved by its effects upon the heart, stomach, bowels, &c., as well as the voluntary muscles. A stimulus applied to the skin, to the mucous membranes, to the internal membrane of the heart, or to the serous membranes, has also the effect of producing contraction of the muscles. And, lastly, if muscular fibre itself be irritated, it contracts; but yet it is doubtful if the stimulus does not act through the medium of the nerves, from the circumstance, that when only a part of a muscle has been irritated, the whole muscle is observed to contract.

The duration of contraction is longer when any voluntary muscle is acted upon by its natural stimulus, namely, the will, than if it be made to contract by any mechanical or chemical stimulus. Indeed, this may be said of all the muscles, that their natural stimuli influence them for a longer period than any artificial excitement.

The general effect produced by the contraction of the muscles in the living body, consists either in producing or preventing motion, both in the solid and fluid parts of the organismus, and frequently of the whole body. The various modes in which they contract may be reduced to the three following:—

First.—Both the extremities of the fibres of the contracting muscle may remain fixed during the time of contraction; as is exemplified in the action of the diaphragm, of the muscles of the abdomen, and of the buccinator.

Secondly.—Both their extremities may be in motion, as happens during the contraction of all the sphincter muscles, as all those of the stomach, and intestines. And,

Thirdly.—One extremity of the acting muscle may be fixed while the other is moveable; this state may be best observed in the contraction of most of the voluntary muscles.

The contraction of a muscle then, on the application of stimuli, sufficiently attests its irritability; but it has been supposed by some, that its irritability is not proved merely by its ordinary contraction under such circumstances, but that it is also manifested in the change which certain muscles are observed to undergo after having been mechanically put upon the stretch, as seen in the extension of the abdominal muscles during uterine gestation, and ascites. It is right, however, to remark, that this phenomenon has received from some physiologists a different explanation; for, regarding the entire length of a muscle as made up of distinct ultimate fibres, united by interposed cellular tissue, they suppose the mechanically increased length of the muscle to result, not from any inherent property of the muscular fibre itself, but from the physical extension of the cellular tissue.

The power of contraction of muscular fibre, upon the application of a stimulus, continues for some time after death; but the precise period for which this capability of being excited lasts is not the same in all muscles; and it also depends upon the state of the individual's health just prior to death, as well as on the cause of dissolution: for it is found that very sudden death, such as that by lightning, removes at once all contractile power in the muscular system. The following order has been of late assumed, as being that according to which the extinction of muscular irritability takes place successively after decapitation. First, the aortic ventricles;

second, the intestines and the stomach; third, the muscles of the urinary organs; fourth, the pulmonary ventricles; fifth, the œsophagus; sixth, the iris; and seventh, the external muscles. The same order of succession takes place when the muscles are detached from the body.

From what has been said of the inherent contractibility of muscle, it is evident that their *use* must be either to move the body from place to place, or to change the form and alter the capacity of certain parts of the body, according to the several functions of those parts. This leads us to distinguish into two principal classes the various combinations of the muscular fibre. Muscles generally may be called the active agents of locomotion, as we are in the habit of terming the skeleton the passive agent; but the alteration in the form and capacity of certain parts of the body, acted upon by the muscular contraction, may be either under the control of the will, or wholly independent of the direction of volition; and therefore we are in the habit of dividing the muscles, according to their uses, into voluntary and involuntary. The former class comprehends all the muscles which are attached to the extremities, and to such parts as are moved by the influence of the will, and are said therefore to belong to *animal life;* while the involuntary muscles, which are stimulated to action by distention from their natural contents, and which form the parietes of hollow organs generally contained within one of these great cavities, maintain functions, the constant performance of which are essential to existence; and hence they are said to be the vital organs: such muscles, therefore, we find influencing the circulation of the blood, and the functions of the stomach and bowels. The action of these muscles seems to depend upon the influence of their peculiar nerves, though not upon the brain; for in brainless monsters the action of the heart and intestines continues the same. But yet it seems that the action of such muscles is, at any rate, influenced by the brain, as is proved by the effects of joy, rage and grief upon the organs of vegetative life; so that it may be justly concluded, that the involuntary functions depend upon the nerves, but are influenced also by the brain.

There is yet a third class of muscles, which seems to form a link between the other two; they are termed the mixed muscles: the best example of which we have in the muscles of respiration, destined to be always in action from the constant necessity of that function, which is usually performed twenty times in a minute; but yet a person has the power of rendering respiration quicker or slower at will: and, further, in difficult breathing, many of the muscles destined under common circumstances to move the upper extremities, exert an involuntary power to assist the respiratory organs.

There are, indeed, such distinguishing marks, both in the construction and function of these three classes of muscles, that it becomes necessary separately to describe them, so that they may be divided by the anatomist, as well as by the physiologist, into distinct classes.

The Involuntary Muscles.

The involuntary, or, as sometimes termed, the internal muscles, are those which belong to vegetative life: they bear separately no particular names, but are denominated according to the organ of which they each form a part.

To this class belong the muscles of the heart, of the alimentary canal, of the uterus, of the urinary organs; and probably also the fibrous structure of the iris and trachea, which some have regarded as muscular and referred to this class, but it has yet to be proved that these fibres are actually muscular.

The muscles of this class are deeply seated, and may be easily distinguished from the voluntary muscles. They are much less bulky, and form hollow cylinders, the internal surface of which is lined by a mucus membrane. Their fibres are of a greyish yellow colour, excepting those of the heart, which are of a deep red; and, unlike the voluntary muscles, they are not furnished with tendinous attachments:

no trace of which structure is to be found excepting in the heart. The directions of fibres in this class are various, being disposed in layers, which are obliquely intersecting each other, so as to produce by their contraction a diminished capacity of the cavity of which they form the parietes. The involuntary muscles are not furnished with antagonists; but when they contract by tending to diminish the size of the cylinders which they form, they are pressed against the substances contained within them, which may, indeed, be said in some measure to antagonize them.

The involuntary muscles sometimes, by their contraction, produce a simultaneous action of the external and mixed class of muscles, which thus assist them in the performance of their functions, as in sneezing, coughing, and vomiting.

The blood-vessels of this class of muscles are said to be very numerous; but it does not seem that they are distributing themselves so much to the muscles as to their lining membrane; and therefore it is doubtful if it be right to describe them according to the usual mode, as receiving more blood than the class of voluntary muscles.

The involuntary muscles derive their nerves principally from the sympathetic, but also a few from the nerves of the spinal marrow; and these nerves are stimulated, or, in other words, the irritability of these muscles is manifested by some local stimulus acting upon their fibres through the medium of the membrane which covers them; so that their action may be said to be independent of the will, although it must at the same time be granted, that strong emotions of the mind do produce an involuntary influence on their action. It would appear that the involuntary muscles are more excitable, and are sooner put into action upon the application of a stimulus, than the voluntary ones; thus it is not uncommon to find the whole intestinal canal excited by the introduction of a foreign body, as a suppository into the rectum; and this action is said to be produced by sympathy; which is, in fact, a term evincing their extreme excitability. The colour of these muscles, the curved direction of their fibres, the variety of their form depending upon the organs to which they are attached, and their want of connection with tendons, are, as I have said, the principal distinguishing marks of the internal or involuntary muscles.

The *mixed class of muscles* are those which, both in structure and function, are intermediate to the voluntary and involuntary; their distinguishing characters I shall describe before those of the voluntary class, as the latter are more especially the object of consideration in viewing the muscular system.

This intermediate class of muscles are named the mixed, in consequence of the voluntary power we possess over them to modify their action; although, at the same time, we cannot by any effect of the will entirely stop the performance of their function for any length of time. The diaphragm, and all the muscles of respiration, are included in this class, as we are enabled to use them quickly or slowly at will, although we cannot by the same effort cease to respire for any length of time; habit, however, renders persons capable of suspending this action for a considerable period, as may be observed in divers. The sphincter muscles may be considered as belonging to this class, for they are not constantly under the dominion of the will.

These muscles differ in structure from the involuntary, in having tendinous attachments, and also in being of a red colour; many, however, resemble them in having their inner surfaces covered by a membrane, and in partly receiving their nerves from the sympathetic.

The irritability of these muscles may be considered as somewhat greater than that of the voluntary, and less than that of involuntary muscles; whilst their power of contraction is also intermediate.

The Voluntary Muscles.

These muscles, which belong to the animal functions, are attached to the bones, and constitute the active power which put those levers in motion. These muscles are firm and solid, and constitute therefore a very considerable portion of the bulk of the human body; they are also of a florid red colour, composed of fasciculi which run parallel to each other, and are usually attached at each extremity to tendons, or some other parts of the fibrous texture, through the medium of which they become connected with the bones. There are but few exceptions in the voluntary muscles to their being found in pairs: the diaphragm and sphincters are considered as these exceptions; but these are rather to be classed amongst the mixed muscles. The size of the voluntary muscles varies considerably; some being of very large, while others are of the smallest dimensions: and their figure also offers numerous varieties; some being very *long*, as those of the extremities; others *broad*, as those which cover the cavities; while those which are attached to the irregular bones, are *short* muscles.

The motions which take place in the human body, as produced by the action of the voluntary muscles, are flexion, extension, lateral inclination, rotations toward opposite directions, abduction, adduction, elevation, and depression; and from the performance of these actions have several of the muscles been named: hence the term flexors, extensors, abductors, adductors, elevators, &c. They sometimes also derive their name from the direction of their fibres, as the obliqui abdominis; from the number of their origins, as the biceps and triceps; from their figure, as the trapezius; from their formation, as including two distinct fleshy portions divided by an intervening tendon, as the digastrici; from their situation and comparative size, as the pectoralis major and minor; and also from their attachment, as the sterno cleido mastoideus, genio hyo glossus, &c.

A classification of the muscles of volition has also been attempted, by dividing them into those belonging to the skeleton, to the larynx, to the organs of the senses, and those of the skin: and if those of the skeleton be subdivided in the manner of the bones into the long, the flat, and the short, the arrangement will be found, perhaps of all others, the best for facilitating their description; those of the larynx and of the senses being treated with the particular description of those parts.

On considering the muscles of the skeleton then, those which are attached to the extremities are of an elongated form; while those of the trunk are broad, and cover the cavities of the skeleton, by which they assist in forming the abdomen, thorax and cranium.

The long muscles attached to the extremities are more or less cylindrical, and have a considerable length of tendon attached to them, even sometimes longer than the muscle itself. When the long muscles extend over the long bones of the extremities, they are generally divided into two layers, of which the external are the longer; as, for instance, may be observed on the arm, the biceps being much longer than the brachialis internus. Muscles of this kind frequently divide into several tendons for their insertion.

The broad muscles are generally thin, and, as I have said, are usually assisting in forming the parietes of the cavities of the body; but beside which, they contribute to the function of the viscera, which they enclose, so that many of them are more justly to be considered as belonging to the mixed, than either to the voluntary or involuntary class of muscles. They generally maintain the same degree of thickness throughout their extent, and frequently arise by mixed digitations, by means of which they attach themselves to many parts. These muscles sometimes cover the long ones, as may be observed on the back: there are some of them which, although from their attenuated form and manner of attachment, resemble this class, yet have their breadth so little beyond their length, that they appear to form a link between this class and that of the long muscles.

The short muscles are generally thick in proportion to their length and breadth, so that indeed their threefold dimensions are nearly equal; they are usually of a square form; they are the strongest of all the muscles, as they contain, in proportion to their size, the most fibres; and they are therefore found in situations where great power and quickness, rather than great extent of motion, is required; as, for instance, in the articulation of the lower jaw with the temporal bones, in the hand, foot, &c.

The middle, or most fleshy part of the muscle, is called the *belly;* the superior part, or that which forms the origin or more fixed point, is termed the *head;* whilst the opposite extreme, or more moveable point of a muscle, is called the *tail.*

In ordinary circumstances, the contraction of a muscle takes place in such a manner as to draw the tail, or point of insertion of the muscle, towards the head, or point of origin; but this is not universal.

The external form of the muscles varies considerably, as well as the direction of their fibres, so as to lead to distinguishing terms of simple, compound, penniform, semipenniform muscles, &c. A muscle is termed simple, when it is composed of a single head and terminating by one tail into a single fixed point; so that the course of all its fibres is exactly the same as the course of the muscle itself, and consequently its force is exercised in the line of its direction; this is the most simple arrangement. Other muscles divide at one of their extremities into several parts, and are called therefore compound muscles; this division may take place at either their origin or insertion, as may be observed in the muscles of the abdomen, and of the toes and fingers; in the former case, the contraction of the whole muscle would give to the moveable part a motion in the mean direction of all the forces employed; while in the latter, the contraction of the single belly would put several parts in motion at the same time. It should be observed, however, that some of the simple muscles seem to form an intermediate link between the simple and compound ones, as the deltoid and subscapular muscles.

The penniform muscles are those which are composed of two sets of fibres, passing to be inserted at a greater or less angle into a single central tendon; the rectus femoris offers the best example of this class of muscles: and when the fibres are inserted into one side of a tendon only in a like manner, it then is termed a semi-penniform muscle. The peculiar use of this oblique attachment of muscular fibres to their tendons, will be mentioned when speaking of the mechanism of muscle.

Mechanism of Muscular Motion.

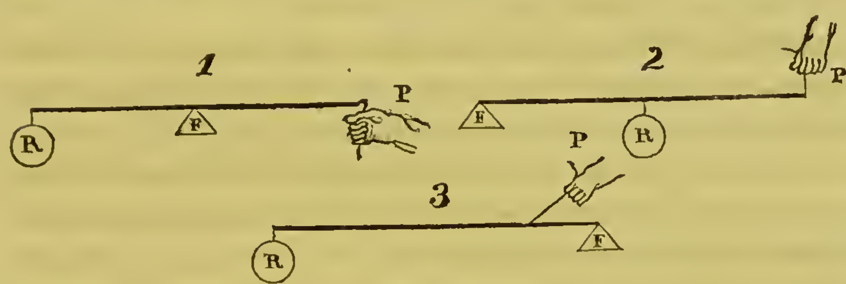
As regards the laws according to which the various muscular motions are effected, it is first to be considered, that the bones are merely the passive organs, and that the muscles may be said to act upon them according to the law of mechanics; the muscles acting upon the bones, and the weight to be raised upon the principle of the lever. But in the investigation of this mechanical law we shall find one great difference in the application of it to the animal frame, when compared with any mechanical instrument; for in the former at first view it seems that the muscular power is not applied to the greatest advantage, but on the contrary, that the force employed is much greater than seems necessary for the weight to be moved; while in machines it is always the object to employ no greater force than is equivalent to the weight: but we shall find, in carrying further this analogy, that there are several advantages gained by this apparent imperfection, which more than compensate for the expenditure of power.

That the mechanical disadvantages at which the muscles act, as far at least as refers to the force they are obliged to use, from the peculiar manner in which they are inserted into bone, may be better understood, I shall first describe the three kinds of lever which are mentioned in mechanics.

The first, and that most commonly used for all mechanical purposes, is, that in which the power is at one end, the fulcrum or fixed point in the centre, and the weight or resistance at the other end; we employ this lever in poking the fire, and other common purposes in which we call the lever in aid; and yet, of the three kinds, this is the least frequently employed in the action of muscles.

The second kind has the resistance in the centre, the power at one end, and the fulcrum at the other.

The third kind is that in which the power is in the centre, the resistance or weight at one end, and the fulcrum at the other. These levers, and their mode of action, may be more easily understood by the following diagram:—



The third kind is the one most used during muscular action in the body, which, according to the laws of mechanics, is the most disadvantageous; but the advantages which are gained by it will afterwards be mentioned in some of the motions of the muscles: however, all three of the levers are employed; for instance, when the head is moved on the first cervical vertebra, the fulcrum is placed between the power and resistance, as in the first lever: when the weight of the body is raised by standing on tip-toes, then the resistance is placed between the fulcrum and the power: and, as the third, in raising a weight in the palm of the hand, by bending the elbow, the power is situated between the fulcrum and the resistance.

This usual application of the lever, which occasions a necessary loss of power to the muscles, is not the only disadvantageous circumstance under which the muscles act, according to strictly mechanical principles; but there are other causes which should also be pointed out:—

First.—That the efforts of some of the muscles are divided, partly by acting upon the bone from which they arise, as well as upon the bone into which they are inserted, both being moveable, producing therefore a loss of power.

Secondly.—From the insertion of many of the muscles being nearer to the fulcrum than to the resistance, which induces the necessity for greater force, and precisely in the proportion as the insertion of the muscle is near to the fulcrum and distant from the weight.

Thirdly.—The oblique insertion of some of the muscles, both as regards their attachment to bone and to tendon, produces a disadvantage in their action.

Fourthly.—The resistance which muscles have to overcome from antagonist muscles, as well as to oppose the weight of the body to be moved. And,

Fifthly.—There is a power of muscles to be expended in overcoming the resistance offered to them, owing to the friction of the surrounding parts.

Having now contemplated the disadvantages in application of the force of muscles upon mechanical principles, it is proper that we should point out some circumstances which are evidently favourable to the purpose of assisting muscular action. In the examples already given of the loss of power, it will be easily shewn, that there are equivalent advantages gained by each adjustment. One of the most unfavourable circumstances to the action of the muscles which is mentioned, is, its insertion being nearer to the fulcrum than to the resistance; which, in the instance of the flexion of the fore arm, is calculated as a loss of fifteen parts out of twenty of the force employed. But it seems a law of the animal economy, that muscular power should be sacrificed for convenience; for if this muscle had been so placed as to require the least power to move the resistance, the muscle would have been placed on the fore arm, and the tendon attached above; but this would have destroyed the symmetry of the limb, and produced a general inconvenience which would have more than counterbalanced the advantage derived from economizing muscular power. And, further, by this arrangement a positive advantage is gained by the velocity with which the point of resistance is thus made to move; so that the advantage may be said to arise from gaining in velocity what is lost in the expenditure of power.

The obliquity of the direction of the muscular fibres also offers advantages during their action; for although by this arrangement power is lost in exact proportion to the deviation of the muscular fibre from the direction of the moving point, still great benefit is derived from the saving of the quantity of contraction, as well as from the additional quantity of muscular fibre which is thus accumulated; for diminishing the necessity of contraction of muscle is a point of great importance, as the fatigue of muscle seems to depend upon the extent of contraction.

Although most muscles have to use an additional force to overcome the action of their antagonists, and thus render an expenditure of power necessary from the composition of forces; still it is clear, that infinite variety and exactness of muscular motion is accomplished by this arrangement, as the moving body can range in every given space between the direct action of the various muscles, and therefore fewer muscles are required. In every example where muscular power is sacrificed, it will be found that some important benefit is derived; and that the symmetry of the body is preserved in such a manner as no other arrangement of the muscular system could admit.

The effects produced by muscular contraction are, the determining both the altitude and the motions of the body in acting upon the skeleton, to move the organs of the senses, to produce modifications of the voice, and to contribute in a greater or less degree to the performance of the vegetative functions. To produce these effects, and particularly when we reflect on the extent of exertion employed, the mind is led to comprehend the wonderful power with which this system is invested. Thus, according to Borelli, the power of the flexor muscles of the thumb is alone equal to four thousand pounds weight: nevertheless, from the disadvantageous circumstances in reference to the attachments of muscles, as already described, they cannot exhibit any thing like that power in raising a weight. The velocity of muscular contraction is equally wonderful: the rapidity of speech, the quickness of motion of the fingers, are all illustrations of the extent of this power.

On Tendons.

In the general description of the muscular system, the tendinous attachment of the muscles have been mentioned as answering the purpose of cords to transmit the force of the muscles—the active organs of motion to the moveable bones; and this important function imposes the necessity of considering their structure, and of pointing out their peculiar properties. Tendons belong to the fibrous tissue which presents itself in the human organismus under this form, as well as that of ligaments, both being of the same tissue, and only so far differing in use, that the ligaments connect bone with bone, while tendons attach muscles to bone. The tendons are commonly found to be situated at both extremities of a muscle; not that they really commence from these extremities; for, by close examination, they may be traced to a condensation of the cellular membrane of the muscle to which they belong, proceeding from the internal cellular covering of all the fibres, as well as from the general investing aponeurosis; and then, forming a thickened rounded cord, passes to be inserted into bone, and, in most cases, by expanding and losing itself in the periosteum. The proportion between the muscles and their tendons is variable; but usually they are thinner than the muscles to which they are connected. The tendons are not always found at the extremities of a muscle, but sometimes in its centre, producing a digastric muscle; and in other instances there are several tendinous intersections, as in some of the muscles of the abdomen: thus dividing the muscles into several parts, and furnishing so many fixed points, towards which the muscular fibres contract and are directed. Tendons are not attached to the involuntary muscles excepting in the heart, where we find the fleshy columns attached by tendon to the valves; neither are the sphincter muscles furnished with tendinous attachments.

Tendons sometimes divide into several ramifications to be attached to separate bones, as the tendons passing from the muscles of the toes and fingers; and in other instances, we find two or more tendons uniting to form one, as the junction of the gastrocnemii soleus and plantaris in forming the tendo Achillis.

The tendons do not usually change the direction of muscular motion, but this change does however sometimes occur from the projection of the apophyses of the bones, as may be observed in the malleoli reflecting the tendons of the flexors of the foot and toes nearly to a right angle; and, indeed, the tendons themselves sometimes send off processes to be connected with other parts out of the direction of their insertion into bone, as the tendon of the biceps both of the arm and leg; the former to produce the fascia of the fore arm, and the latter to be connected with the posterior ligament of the knee-joint. The tendons are furnished with cellular sheaths, which resemble in their use the periosteum of bone and the perichondrium of ligament; and they are in some situations tied down by annular portions of ligament as they pass over bone; in which case these envelopes are furnished with a synovial membrane to protect them from injury by friction: besides this, where tendons pass close to bone, they are frequently converted into a fibro-cartilaginous tissue, and even in some instances into bone itself, to render them better able to bear friction and pressure. The tendons are enclosed in a sheath of loose cellular membrane, which secretes a fluid to lubricate their surfaces, and facilitate their motion; into this membrane small blood-vessels may be traced conveying red blood, but they cannot be demonstrated passing into the tendons themselves; a circumstance which depends partly upon their diminutive size, and partly because they circulate only the transparent constituents of the blood.

Tendon, from its physical properties, as its extensibility and great strength, is in the best possible manner adapted to its peculiar function of communicating the force of muscle to the bones; and also from its comparative little vitality, it is but rarely affected by disease, although it possesses enough of vital principle to be able to repair itself when ruptured, of which we have frequent examples in rupture of the tendo Achillis. In this case, the agglutination does not at first enjoy all the properties of tendon; but in the course of time, when influenced by the action of the muscles, it becomes hardened as the original tendon. Mr. Charles Bell has likened the construction of tendon to the most perfect mode of rope-making; and observed, that it is hatchelled, straided and twisted in the same manner: and superadded to this mechanism, it is influenced by a vital principle, which renders it superior both in strength and adjustment, as well as capable of maintaining its own growth and perfection.

Practical Remarks.

The diseases of tendons are but few, as indeed might be supposed from their structure and essential physical properties—extensibility and cohesion; which well qualifies them to transmit the action of the muscles to the passive organs of motion—the bones; but it is found that they are susceptible of injury, although by some it has been believed that they do not possess nerves and vessels: a strain however, produced by an inordinate action of a muscle upon a tendon, will at once prove the existence of nerves, which are sensible to the undue application of their function; although, when exposed, they are not pained by cutting or rubbing: a mechanical injury to which, in their naturally covered situation, they are not liable: hence the physiologist must infer, that nerves are only susceptible of painful sensation and injury from such causes as, in a less degree, are the natural stimuli to the functions which they are destined to perform. Puncture and laceration however produce in them swelling and agglutination to surrounding parts, which requires a length of time to reduce. The cellular sheaths of tendons are liable to inflammation and to its effects; and if going on to suppuration, the tendons are frequently left bare, but yet remain uninjured.

The Synovial Capsules of Tendons.

These capsules are found connected with the tendons of the muscles wherever they are exposed to friction, and whatever may be the structure over which they pass; hence they are placed between tendon and bone, tendon and ligament, between two tendons, and further, between tendon and cartilage. The number of these membranes, which are termed bursæ mucosæ, is said to amount to upwards of one hundred and forty. These bursæ are of different sizes in different parts of the body, and are said to be larger in children than in adults: their figure also varies; they sometimes form round vesicles, connected on one side with the tendon whose motion they are destined to facilitate, and on the other with the structure over which the tendon glides; at other times they form lengthened vaginal sheaths, lining canals, through which tendons pass, and, proceeding from one large synovial capsule, divide into as many sheaths as there are tendons and canals. This mode of arrangement may be observed at the wrist and ancle-joints, for the tendons of the toes and fingers. The superior oblique muscle of the eye, and the tensor palati, offer another variety of bursa mucosa facilitating the motion of tendons over cartilage. These bursæ resemble very much the synovial capsules of joints, and bear the same resemblance to the large serous cavities, in producing a closed sac without any external opening; their organization seems to be similar to the rest of the serous tissue, as if formed of condensed cellular membranes; their blood-vessels may be demonstrated, although absorbents and nerves cannot be traced to them. The secretion from these capsules of the tendons is viscid, and in its physical properties very much resembles the white of an egg: its chemical analysis has the same results as that of the synovia of the articular capsules. There are also within these bursæ small masses of fat, with fringes, prolonging themselves into the cavity, but covered by the membrane of the bursa; and upon which the small ramifications of the arteries may be traced. The synovial capsules of tendons being, in organization and function similar to the articular capsules, they are liable to the same morbid changes, both from age and disease. In old age they become firmer, less flexible, and secrete less synovia than during youth: hence the stiffness of the motions of the fingers and joints of old people. The successive development of these membranes in the human body is not well understood: according to some, they exist in a greater number during infancy; and become enlarged, and run into one another, in old age.

Practical Remarks.

The synovial capsules of the tendons are liable to inflammation; and although perhaps less so than the serous membranes lining the large cavities, yet, as in them, inflammation encreases and alters their natural secretion, producing frequently an accumulation similar to hydrops articuli, but which in this situation is termed ganglion. The bursa between the ligamentum patellæ and tibia, and the synovial capsules connected with the tendons about the wrist, are particularly liable to this disease. These tumours contain a viscid fluid of a yellowish red colour, consisting of a considerable quantity of albumen. The cause of their formation is generally unknown, although at times it may be traced to pressure: hence the frequent occurrence of ganglion of the bursa below the knee of house-maids. On the increase of the synovial fluid and consequent enlargement of the bursa interfering with the motions of the tendon, it is the object of the surgeon to promote the absorption of the fluid; and in many cases this object may be gained by blisters and pressure; but in others, where the synovial capsule is very much thickened, and the fluid itself inspissated, these local means will not avail, and puncture or setons are recommended: but as far however as my experience leads me to judge, I should be cautions with this mode of procedure, as I have several times seen the very worst effects follow this treatment; and I should always reprobate it when the ganglion is situated in the neighbourhood of a large joint. I have frequently known the dispersion of the fluid, by bursting the sac with a sharp blow, produce at once a radical cure.

Chronic inflammation of the bursæ does sometimes produce ulceration: sometimes the formation of cartilaginous bodies within the sac— a disease very similar to the formation of loose cartilage within the articular synovial capsules: and further, a long continued inflammation does sometimes produce a secretion of a pulpy nature, resembling pieces of pear, which seem to be imperfectly organized adhesive matter, filling up the synovial sac. In such cases the constitution is usually impaired, and requires, therefore, a strict medical, as well as local treatment.

LECTURE XIII.

DESCRIPTIVE ANATOMY OF MUSCLES.

Introductory Remarks.

In the arrangement or classification of the muscles, the object is in the clearest manner to direct the student to a thorough knowledge of this system, both anatomically and physiologically; but in this a considerable difficulty arises from the impossibility of arranging them so as equally to facilitate the mode of investigating them by dissection, and classifying them according to their uses. It has already been shewn that the muscular system, from the peculiar power it has of contraction, serves to give motion to every part to which it is attached: physiologically, therefore, muscles might be arranged according to their respective uses: as those which act especially upon the osseous system, those which move soft parts, and those, the object of which is to assist other organs in the performance of their respective functions. Now, to adhere to such a description of the muscular system, would be to assume what cannot by any means be conceded—that each muscle, or set of muscles, performs a single and exclusive function; and that every individual purpose is effected by a particular muscle, or set of muscles. But although such assumptions prove applicable to machinery, formed by ingenuity of man, they are found altogether at variance with the wisdom and power displayed in the construction of the living human body. No such singleness of purpose is here to be found; but, on the contrary, by an equally wonderful and beautiful contrivance, an individual muscle, or a partial set of muscles, is made subservient to a variety of important objects: thus we have the muscles attached to the bones of the chest subservient at once to the act of respiration, to the expulsion of the fæces, and to the motions of the body upon the pelvis; whilst innumerable instances, equally striking, might be adduced to illustrate the same principle. Even physiologically, therefore, such an arrangement as that I have just alluded to, would prove extremely inconvenient and imperfect; whilst, to the student engaged in actual dissection, it would not only be perfectly useless, but tend to mislead and complicate his study.

Another plan, perhaps better calculated to assist the pupil in acquiring and retaining a knowledge of the muscular system, is, to specify numerically the whole of the muscles of a particular part or region of the body, with a corresponding numerical subdivision, according either to their origins and insertions, or to their individual and combined uses. Such a plan has long appeared to me to be of the greatest use in teaching anatomy; and, indeed, I may conscientiously say, that the advantages in its adoption in my lectures, have been felt and frequently acknowledged by those most interested in the result.

An objection, nevertheless, immediately presents itself to such a plan, in its inapplicability to the purposes of practical anatomy; for, to the dissector, the principal object is, to be prepared to recognize the various parts and structure brought into view as he proceeds in his dissection: an object, indeed, altogether indispensible. Such a plan, accordingly, has been occasionally adopted: the various parts, layer after layer, being described as they presented themselves in the progress of dissection; but it is a plan which is not very easy or very scientific to adhere strictly to, either in lecturing or in an elementary treatise, without producing great confusion and embarrassment, inasmuch as both the proper and compound action, as well as the individual uses of muscles, must yield to mere mechanical position. Finding, therefore, all these plans themselves more or less imperfect, it will be my endeavour so to avail myself of, and combine the advantages of each, as to render this elementary work, if possible, useful alike to the reading student and to the practical anatomist. It is my intention, with this view, in the first place to specify numerically the muscles of particular parts and regions of the body, with corresponding numerical subdivisions, according to their origins and insertions, as well as to their respective and combined uses: thus, for instance, in the description of the muscles of the upper extremity, it may be first observed, that there are fifty-one muscles which give motion to the bones of the arm; but as these bones form numerous joints, the muscles must secondly be divided in such a manner as to specify what joints each set are destined to move; so that, in the second place, they may be subdivided into the seven muscles connecting the scapula to the trunk, the nine muscles of the shoulder-joint, the four muscles of the elbow, the four muscles of the radio-ulnar articulations, the six muscles of the wrist-joint, the five muscles common to the fingers, the eight muscles proper to the thumb, two of the fore finger, three muscles of the little finger, and one common to the skin and fascia of the palm of the hand; by this arrangement both the muscle and uses of each set of muscles is understood; but yet, has to be learnt, the origin and insertion of each muscle, and their relative position with respect to each other: a knowledge which can only be acquired by dissection. Now, to facilitate this mode of investigation by description, a third and further division must be adopted to lead the student progressively on to the desired object: thus for instance, in dissecting the muscles of the scapula, his task is rendered easier by knowing that there are two muscles situated above the scapula to raise that bone, three placed behind to draw it backwards, and two in front and on its inner side to draw it forwards and towards the trunk. By prosecuting the dissection of the muscles according to this classification, the relative position of the muscles is necessarily learnt as well as their attachment; and the dissector learns that all these muscles arise from the bones of the trunk, and are inserted into the scapula. There is now only left for him to study the direction of the fibres of each muscle; and their individual action is rendered apparent by the knowledge, that a muscle, when contracting, must of necessity draw the more moveable point towards the more fixed one, in a direction precisely opposite to that of the fibres of the muscle in action. The muscles of the shoulder and elbow-joints admit of equal facility of dissection according to their uses, as they are not concealed by the muscles of any other articulation; but those of the radio-ulnar joints and of the wrist and the fingers, are more complicated in consequence of their being so connected with each other as scarcely to admit of their being dissected in the order of the joints to which they belong, but require to be arranged in layers as they present themselves to view in the progress of their dissection: thus it may be premised, that the muscles situated between the radius and ulna, both anteriorly and posteriorly, belong in part to the radio-ulnar, wrist, and articulations of the fingers. Those situated in front are eight in number: they principally arise from the internal condyle of the humerus, and are disposed in two layers, five being placed superficially, and three of them deeply seated: and in the same manner the eleven muscles filling up the space between the radius and ulna behind, are forming two layers—six of them being superficial, whilst five are deeply seated: the muscles in the superficial layer principally arise from the external condyle of the os humeri. Muscles situated on the hand are also placed so as to preclude the possibility of dissecting them so as to expose them in order, according to their uses: but they may be readily understood by the following classification: the first muscle seen upon removing the skin from the palm of the hand is the palmaris brevis—a muscle proper to the skin and fascia of the hand; and on removing this muscle, with the palmar fascia on the outer side of the hand, the muscles proper to the thumb are exposed; and on the inner side, those of the little finger; while in the centre, there are superficially placed, the tendons of the flexor sublimis and profundus digitorum, with the lumbricales; and deeply seated, the interossei. On the back of the hand the muscles are less numerous and complicated; being only the extensors common to the fingers, with the interossei.

I have, in this introduction to the description of the muscles, mentioned those of the upper extremity merely to point out the difficulty of their classification and the mode I wish to adopt to facilitate their arrangement; and shall now proceed, as is usual in ours, as in most schools, to the muscles of the abdomen.

The Abdominal Muscles.

The exterior muscles of the abdomen belong to that class denominated in the physiological classification, flat or broad muscles; being composed of parallel fibres terminating in thin expanded aponeurosis, and situated in those parts of the frame where a great extent of surface is required to afford muscular parietes to cavities, for sustaining and assisting the function of the important organs which they contain.

They consist of five pairs: the obliqui, externi et interni, the transversales, the recti, and pyramidales. The obliqui transversales and recti, are named from the direction of their fibres; while the pyramidales have derived their name from their form.

Previous to the particular description of these muscles, it is necessary to make some observations on the method of exposing them in the course of their fibres, in order that the dissection may be clearly and dexterously performed. First, an incision should be made from the cartilago ensiformis to the symphisis pubis; the second incision should divide the integuments in an oblique direction upwards and outwards, beginning from the umbilicus, and extending over the ribs as high as the sixth; and the third incision is then to be made downwards and outwards, from the umbilicus to the crista of the ileum. On raising the skin from the fibres of the muscle it is to be observed, that a condensed cellular tissue is also raised with it, which is situated on the whole anterior surface of the abdomen, between the skin and the muscles, being sufficiently thick and demonstrable to derive the name of *fascia superficialis*.

This subcutaneous aponeurotic membrane covers the anterior and lateral parities of the abdomen; it is dense and strong inferiorly, and is continued upon the thigh laterally; while in the middle inferior part of the abdomen it passes downwards, so as to give a covering to the organs of generation; passing over the external ring, and proceeding from the scrotum in the male, and the labia pudendi of the female, it becomes the superficial fascia of the perineum: superiorly it passes upwards upon the thorax, and is continuous with the cellular membrane covering the platisma myoides muscle; while, laterally, it becomes more and more attenuated, until it is lost in assuming the appearance of common cellular membrane. This fibro-cellular membrane is somewhat elastic, and strengthens the muscular parietes of the abdomen; it becomes an object of interest in pathological as well as in anatomical considerations, as forming one of the coverings in herniæ, being sometimes so thickened as to present a very dense and important structure. This fascia being cleanly dissected from the muscular and tendinous parietes of the abdomen, the external abdominal oblique muscles are seen forming the lateral regions; while a tendinous structure occupies the central and lower part of the abdomen, producing several white tendinous lineæ, rendered more opaque than at other parts by the junction of the tendinous insertion of the abdominal muscles.

The *linea alba* is situated in the middle line, and extends from the sternum to the pubes; it is formed by the union and interlacement of the tendinous expansions of the musculi obliqui and transversales. In the centre of this line is situated the umbilicus, which is a cicatrix filling up an opening which, in the fœtus, gives passage to the parts producing the umbilical cord; the linea alba is broadest at this part, above it is thin and semi-transparent, below it is dense and opaque.

On either side of the linea alba, and from three to four inches distant from it, is a crescentic white line, having its convexity turned outwards; it reaches from the junction of the cartilage of the eighth with the seventh rib to the upper part of the pubes, opposite to the spinous process of that bone, and is termed the *linea semilunaris.* This line is formed by the junction of the tendons of all the flat muscles of the abdomen; and, indeed, is the point where these muscles become tendinous. There are also lineæ to be observed which pass transversely from the linea alba to the lineæ semilunares, which are termed the *lineæ transversales,* and usually, though not always, are found in the following situations: the first one is generally opposite the cartilage of the last true rib; another midway between this and the umbilicus; a third opposite to the umbilicus; and, lastly, midway between the umbilicus and the pubes a fourth is found, but this usually is but half the length of the others. This tendinous expansion forms a complete aponeurotic boundary to the lower part of the abdomen, reaching across from the one anterior superior spinous process of the ileum to the other, and connected with the pubes in the middle line in such a manner as to produce a free edge on each side of the pubes, which is termed Poupart's ligament; and which will be better understood when the origin and insertion of the external abdominal oblique muscle has been described.

The *musculus abdominis obliquus externus descendens* is situated throughout its extent immediately behind the fascia superficialis, and forms the first muscular layer of the anterior and lateral boundaries of the abdomen: it is fleshy superiorly, posteriorly and laterally: and tendinous at its lower and anterior surface. This muscle *arises* from the eight inferior ribs, close to their cartilages; on the fifth and sixth ribs it is, by tendon and muscular fibre, connected with the pectoralis major; on the sixth, seventh, eighth, ninth, and tenth, it digitates with the serratus magnus muscle; and on the eleventh and twelfth ribs it connects itself with the latissimus dorsi, which partly covers it. From these origins the fibres pass downwards and inwards to be *inserted* into the two anterior thirds of the outer edge of the crista ilii, forming a free posterior fleshy edge, which passes vertically from the last rib to the ilium; the fibres of the muscle are then continued obliquely downwards and forwards to the linea semilunaris, and are there intimately blended with the tendons of the internal oblique and transversalis muscles; from this line its tendinous fibres are continued in the same direction with its fleshy fibres to the middle of the abdomen, where, by interlacing with the tendon of its fellow of the opposite side, they together form the linea alba, into which it is said they are *inserted;* but besides this insertion, the iliac portion of the muscle also sends forth a tendon from the anterior and superior spinous process of the ilium, which forms a thick free edge, passes over the flexor muscles, vessels and nerves of the thigh, to the upper part of the pubes, to which it is fixed; being however above continuous with the rest of the tendon of the external oblique muscle. This free edge is termed Poupart's ligament, and forms the crural arch; its connection with the os pubis is threefold, as about an inch and a half from the bone it splits into two pillars, and thus produces an opening which is termed the external abdominal ring; the superior and internal pillar is broad and flattened, and is attached to the symphisis pubis, its fibres decussating those of the opposite side; the external and inferior pillar is round and strong, and passes to be inserted into the spinous process of the pubes; and from the posterior edge of this pillar a thin process of tendon runs backwards and outwards to be attached to about half an inch of the linea ilio pectinea, which is termed Gimbernat's ligament: it produces a concave edge looking upwards and outwards, and forms a boundary to the inner side of the femoral sheath. Where Poupart's ligament divides into the two pillars to be attached to the pubes, as has already been mentioned, a space is left, which is termed the external abdominal ring;

having its upper and outer angle strengthened by cross tendinous fibres. This opening is of a triangular form, directed obliquely downwards and inwards, and is broader above than below; it is for the purpose of giving passage to the spermatic cord and cremaster muscle in the male, and to the round ligament of the uterus in the female. This space, however, is not to be considered as being left open as a communication between the outer and inner parts, being closed within by the tendons of the obliquus internus and transversalis muscles, and externally by the fascia of the cord and the fascia superficialis; it is, however, through this space that the bowels protrude in inguinal hernia.

Several openings are to be observed in the aponeurotic portion of the obliquus externus, besides those already mentioned, which are for the passage of the ramifications of blood-vessels and nerves, and which sometimes permit the protrusion of the abdominal viscera, producing what is termed ventral hernia.

The fleshy fibres of this muscle vary, both in their length and direction, in different parts of its extent; its upper fibres are short, and nearly vertical; the middle are the longest, and descend from without to within; while the posterior fibres are thick, short, and pass nearly vertically from the last ribs to the ilium: so that the result of the action of this muscle depends upon a direction given to the moveable parts in a line intermediate to the combined forces of its collective fibres.

Use.—The obliquus abdominis externus descendens contracts the capacity of the abdomen, consequently compresses the viscera of that cavity, and assists therefore in the passage of their contents; it also acts violently in vomiting, and assists in the expulsion of the fœtus. It depresses the ribs, diminishes therefore the capacity of the chest, and acts in expiration, in coughing, sneezing, laughing, &c.; and by pressing the viscera against the diaphragm, is indirectly producing hiccough. When acting singly, they incline the thorax obliquely downwards to the opposite side of that muscle which is in action; and when they both act, the thorax is drawn directly forwards and downwards towards the pelvis. In the recumbent posture, and in climbing, these muscles raise the pelvis and lower extremities towards the thorax; they also render the fascia lata of the thigh tense; and lastly, act as opponents to the sterno cleido mastoidei by depressing the sternum.

To expose the second layer of the abdominal muscles, the m: obliquus externus must be separated from its costal and iliac attachments, and its tendon divided a little above Poupart's ligament, from the anterior and superior spinous process of the ilium to within an inch of the external abdominal ring; the whole muscle is then to be reflected towards the linea semilunaris.

The *obliquus abdominis internus ascendens* is thus exposed: in form it resembles the last described muscle, but its fibres pass in a contrary direction: it is more fleshy below than above; it is covered in front by the obliquus externus, posteriorly by the latissimus dorsi, and lies upon the musculus transversus abdominis. The internal oblique muscle *arises* posteriorly from a very strong fascia, common to this and other muscles, which is termed the fascia lumborum, and which is formed of three aponeurotic membranes; the posterior layer proceeding from the spinous processes of the lumbar vertebræ and sacrum; the middle one, from the apices of the transverse processes; and the anterior and thinnest layer, continuous with the fascia iliaca, passes over the quadratus lumborum, and thus forms sheaths for the lumbar muscles. From the strong posterior layer of this fascia, from the whole length of the middle labium of the ilium, and from the outer half of Poupart's ligament, the internal oblique muscle *arises*; from its fascial and posterior iliac origins the fibres are directed obliquely forward and upwards to the thorax; from the anterior part of the ilium they take a transverse course to the median line, and from Poupart's ligament they incline obliquely downwards and inwards towards the pubes, presenting below a free and slightly concave edge. The obliquus abdominis internus is *inserted* tendinous into the cartilago ensiformis; tendinous and fleshy into the edges of the cartilages of the six inferior ribs. At the linea semilunaris this muscle becomes wholly tendinous, and is connected with the external oblique muscle; but here the tendon of the internal oblique splits into two layers, the anterior of which, with the tendon of the external oblique, passes in front of the rectus muscle to be inserted into the whole length of the *linea alba;* while the posterior layer, accompanied by the tendon of the transversalis muscle, passes behind the rectus to the same insertion, excepting at its lower fourth, where it is said to pass in front, but should rather be described as becoming here so attenuated as to be lost in cellular membrane. Those fibres of the muscle arising from the outer part of Poupart's ligament form a tendon which pass in front of the spermatic cord, behind the external ring, and is inserted into the symphisis pubes, being connected intimately with a similar tendon of the transversalis muscle.

Use.—The use of this muscle is to assist the external oblique muscle of the abdomen in all its actions; but it is to be remembered, that the internal oblique of the one side, cooperates with the external oblique of the other, in producing the rotatory motions of the trunk.

To expose the third layer of the abdominal muscle, the internal oblique muscle should be raised from the cartilages of the ribs, from the fascia lumborum and from the crista of the ilium as far forwards as the anterior and superior spinous process; immediately below which point it is so strongly adherent to the transversalis muscle, that care must be taken that its fibres are not raised with it; this may be avoided by observing branches of the circumflexa ilii artery, which are between them: the muscle is then to be reflected as far as the linea semilunaris, the portion arising from Poupart's ligament being left in its natural situation.

The *musculus abdominis transversus* is thus exposed: it is broader before than behind, fleshy at its superior lateral and inferior aspects, but tendinous at its anterior and posterior surfaces: its exterior is covered by the two last described muscles, while its interior face is in contact with the fascia transversalis, which separates it from the peritoneum: this fascia will be described when speaking of the parts connected with hernia. The musculus transversalis abdominis *arises* tendinous from that layer of the fascia lumborum which is connected with the transverse processes of the last dorsal, and four superior lumbar vertebræ; also tendinous from the posterior part of the ilium, fleshy from the remaining part of the middle labium ilii, and from the posterior surface of the outer third of Poupart's ligament, in connexion with the obliquus internus: above it *arises* from the seven inferior ribs, tendinous from the two last, and fleshy from the five superior, where it is in contact with the origins of the diaphgram, but does not distinctly, as is usually described, indigitate with them. From these points of attachment the fibres pass transversely to the linea semilunaris, there become tendinous, and accompany the posterior layer of the tendon of the internal oblique muscle behind the rectus in the upper three-fourths of its extent to be attached to the linea alba, while the lower fourth passes with the anterior layer of the tendon of the obliquus internus and externus muscles to be *inserted* into the same line; that portion arising from Poupart's ligament in common with the musculus obliquus internus is attached tendinous to the pubes, forming with it an inseparable insertion.

Use.—The transversalis muscle, by its contraction, diminishes the capacity of the abdomen, and necessarily compresses the viscera of that cavity in a similar manner to the oblique muscles, forcing up the diaphragm into the chest; but it further lessens the capacity of the thorax, by drawing the ribs on one side towards those on the opposite; it also assists in the contortions of the trunk.

The *musculus cremaster* is a small muscle which, in the male, passes out through the external abdominal ring, completely surrounding the spermatic cord; it is composed of fibres which are given off from the internal oblique and transversalis muscles, although it is sometimes described as having a distinct origin from Poupart's ligament and the os ilium; it then passes down with the cord, and spreads itself to be attached to the tunica vaginalis reflexa, into which it is inserted. During the fœtal period, this muscle seems to take its course upwards along with the gubernaculum, through the internal ring, and may therefore be considered as aiding, if not producing the descent of the testicle; this idea, perhaps, may be further strengthened by the fact, that there are no corresponding muscular fibres in the female. The cremaster muscle forms one of the coverings in inguinal hernia in the male, and its fibres are in these cases sometimes found very much thickened; it compresses and draws the testicles upwards towards the external ring.

The reflected muscles should now be placed in their relative situations, and the remaining muscles of the abdomen may be dissected by making an incision from the junction of the cartilage of the eighth with the seventh rib downwards to the spinous process of the pubes; by this incision you divide the anterior layer of the sheath of the rectus midway between the linea alba and semilunaris, and expose the

Musculus rectus abdominis, which is a long flat muscle passing vertically in the anterior and middle part of the abdomen; *arising* by tendon from the fore part of the pubes, it ascends, becoming broader and thinner, to be inserted into the ensiform cartilage, and into the cartilages of the three inferior true ribs. In this extent, the rectus muscle is not composed of one uninterrupted course of muscular fibre, but is divided by the three tendinous intersections of the lineæ transversæ; which have been before described as passing from the lineæ semilunares to the linea alba. The rectus muscle on either side is enclosed within an aponeurotic sheath, which has been explained by the account given of the insertion of the oblique and transverse muscles of the abdomen; namely, that the whole of the tendon of the external oblique and half of the tendon of the internal pass in front of the rectus muscle to be inserted into the linea alba; while the posterior half of the internal oblique, and all of the tendon of the transversalis abdominis passes behind it, excepting in the space below the point, midway between the umbilicus and os pubis, where all the tendons pass in front of the rectus muscle ; or, more properly, it may be said, at this point they are lost in cellular membrane: so that the recti muscles at this lower part of the abdomen have nothing intervening themselves and the viscera but the thin fascia transversalis and peritoneum, enabling them more effectually to compress the viscera of the pelvis,—which is one of the principal uses of these muscles,—as well as to bend the trunk forwards, and to raise the pelvis towards the thorax.

In the lower part of the sheath of the rectus, on each side of the linea alba, there is frequently found, although not so often in the male as in the female, a muscle, which is named from its form the

Musculus pyramidalis; it *arises,* broad and fleshy, from the superior part of the pubes anterior to the origin of the rectus, from which it is separated by the aponeurosis of the transversalis muscle; while anteriorly it is bounded by the united tendons of the internal oblique and transversalis muscles, and superior pillar of the external ring: from its origin it passes upwards and inwards to be inserted into the linea alba midway between the pubes and umbilicus.

Use.—The use of the pyramidalis is to assist the rectus in compressing the viscera of the pelvis (hence more frequently found in the female than the male), and to render the linea alba tense. Its directions of action are downwards and outwards; it is occasionally found on one side only.

These five pairs of abdominal muscles being dissected, the student should consider their collective uses ; and he will see how the use of each is common to them all. They all form the parietes of the abdomen: and the direction in which these fibres cross each other, adapt them in the best possible manner, not only to sustain the viscera contained within the abdomen ; but also at the same time to prevent their protrusion. They are also by their contractions destined to assist in the function of these viscera. We therefore find an arrangement, that their force may be equally applied through every part of the abdomen ; and to effect this, it will be found, that the tendinous part of the one muscle corresponds to the fleshy part of another, so as to preserve an equal thickness and power throughout. They all tend, also, to draw down the ribs, and to diminish therefore the capacity of the chest in a direction which may be readily comprehended by attention to the origin and insertion of each muscle.

Until of late years, such an account as I have already given finished the description of the abdominal parietes. It was left to Sir Astley Cooper to discover a structure, which, in a pathological point of view, is of the greatest possible importance; as hernia, before this discovery, could but have been imperfectly understood. In the year 1801, on the failure of an operation for hernia performed by one of the ablest surgeons of the metropolis,—who considered that he had returned the protruded intestine into the abdomen, but notwithstanding which the patient died under a continuation of the symptoms of hernia,—it was found, upon a *post mortem* examination, that, although the intestine had been pushed behind the transversalis muscle, it still remained external to the abdominal cavity. It was this circumstance which led to the discovery of a structure which had not hitherto been understood by anatomists. Sir Astley Cooper, whilst making a careful examination of the abdominal parietes, upon raising the transversalis muscle from what he supposed to be the peritoneum, discovered that a fibrous tissue was interposed, lining the whole of the inner surface of this muscle. To this structure he gave the name of *fascia transversalis.* The importance of this fascia may be inferred, from its forming a passage to the spermatic cord, and thus becoming implicated in inguinal hernia; and from its passing down upon the thigh, thereby being equally involved in femoral hernia. But before entering into the minute account of this important fascia, so that all its various relations may be comprehended, it will be well to bring to the student's recollection the great and open space which is left between the cavity of the abdomen and the thigh: a space bounded behind by the pubes and ilium, and in front by Poupart's ligament; in which latter situation it is so occupied by muscles, arteries, veins, nerves, absorbents, and fasciæ, passing from the abdomen to the thigh, as, under ordinary circumstances, to prevent the descent of the abdominal viscera. With these preliminary remarks, I may now proceed to the account given by Sir Astley Cooper of the fascia transversalis. It may be said to proceed above from the common origin of the diaphragm and transversalis muscle, in which situation, and as it proceeds laterally, it is so attenuated as to be scarcely distinguishable from the common cellular membrane; but as it descends between the transversalis muscle and peritoneum, towards Poupart's ligament, it assumes the distinct fibrous tissue; and in the iliac region, midway between the spinous process of the ilium and pubes, it divides itself into two portions—an outer or iliac, an inner or pubic portion; and these portions so separating as to produce a space termed the internal ring. The iliac portion, which is the stronger, is firmly attached to the inner labium of the crista ilii, and terminating by being inseparably connected with Poupart's ligament in such a manner as to present a concave edge facing towards the pubes, and forming the outer margin of the internal ring. *(Vide Plate* I. 1, 1.*)* The pubic or inner portion, which is thin, less distinct, and on a plane posterior to the other, passes downwards, leaving an edge concave outwards to form the inner margin of the ring *(Vide Plate* I. 2, 2, 2, 2.*)* and is continued downwards behind Poupart's ligament into the thigh, where it forms the anterior layer of the sheath of the femoral vessels, and may be traced as far as where the femoral artery penetrates the tendon of the adductor magnus. The pubic portion of the fascia transversalis, before it passes Poupart's ligament, is firmly connected with the united tendons of the internal oblique and transversalis muscles; and being situated immediately behind the external ring, assists in shutting out that opening from the abdominal cavity.

The Anatomy of Hernia.

In the dissection of the abdominal muscles and fasciæ, all the parts connected with inguinal herniæ are exposed, and should be most minutely examined in the following order.

The skin and superficial fascia being removed from the lower part of the abdomen, the aponeurotic expansion, or tendinous insertion of the external oblique muscle, is to be observed passing by a distinct free edge obliquely downwards and inwards from the ilium to the pubes; and within an inch of that bone it splits into two pillars, so as to form an opening called the external abdominal ring; which is described usually as being of a triangular form, the pubes constituting the base of the triangle, and the point of separation of the tendons the apex: but if the external angle of the ring be examined carefully, it will not be found pointed, in consequence of some transverse fibres which pass from one pillar to the other, thus rounding it off so as, in fact, to make this the large part of the opening, the size of which varies much in different individuals; sometimes forming such an aperture as just to allow of the passage of the cord, and in other instances producing a considerable separation. The external ring, however, is not to be considered as a distinct opening; for, from the edges of the pillars, a thin fascia proceeds along the cord, giving a covering to it so as to form a prolongation like the finger of a glove: and besides this, the fascia superficialis also tends to close it; and both these fasciæ must therefore be cut away before the pillars of the external ring can be brought into view. The dissection of the parts of hernia is further prosecuted by making an incision through the tendon of the external oblique, beginning an inch above the external ring, and carrying it outwards to the ilium; then separating the edges of the cut tendon, the parts underneath are exposed, and immediately the cord in the male subject, and the round ligament in the female, will present itself to view, taking a course obliquely upwards and outwards to a point midway between the superior spinous process of the ilium and pubes, where it is lost by passing into the abdomen through the internal ring. The space between the two rings is termed the inguinal canal. In the female subject, this canal is better defined; first, because of its greater extent in consequence of the great breadth of the pelvis; and, secondly, because there is no cremaster muscle; but in both subjects it presents the following distinct boundaries.

Above, by the free edges of the internal oblique and transversalis muscles, as they are passing from the outer third of Poupart's ligament to be inserted tendinous into the pubes.

Below, by Poupart's ligament.

Anteriorly, by the tendon of the external oblique muscle; and,

Posteriorly, by the pubic portion of the fascia transversalis, which is passing down behind Poupart's ligament upon the thigh to form the anterior layer of the sheath of the vessels. As has been mentioned, this canal is occupied by the spermatic cord in the male, which should now, in this course of the dissection, be more minutely examined; and it will be found to be completely surrounded by muscular fibres; anteriorly by the cremaster, and posteriorly by fibres of the transversalis muscle; so that it is, in fact, running through a muscular canal. The space between the two rings measures from two to three inches, which is therefore the length of the inguinal canal. The internal ring should next be examined, which will be found just as the external,—not to be a hole through a membrane, but an aperture left by the division of the fascia transversalis into two portions; nor can this aperture be distinctly seen, until a small delicate fascia, which proceeds from the edges of the ring to the cord, be cut through; and then the cord itself may be seen passing into the abdomen through the internal ring, and getting between the fascia transversalis and peritoneum, is lost to the view. There is yet connected with these parts a most important vessel to be observed, the epigastric artery, which is given off by the external iliac artery close to Poupart's ligament, passes upwards towards the umbilicus, behind the pubic portion of the fascia transversalis, and consequently behind the cord, and may be seen just on the inner side of the internal ring; the cord, at this point, being on its outer side. *(Vide Plate* I. 3.) It is the knowledge of the relative situation of this artery, which renders the division of the stricture in inguinal hernia safe; whereas, ignorance of it, may lead to fatal consequences.

The protrusion of any of the abdominal viscera through either or both of the rings, is termed an inguinal hernia; but these displacements do occur under such different circumstances, as to have led surgeons to divide inguinal hernia into different species, naming them variously; partly in consequence of their direction, partly from their situation, and partly in reference to their relative position with the epigastric artery. The most common kind is termed *oblique inguinal hernia;* or, by some anatomists, *external inguinal.* The first name describing its oblique course, and the second its being situated on the outer side of the epigastric artery.

This hernia passes through the internal ring, bringing with it a portion of peritoneum, which is called the hernial sac; it forms a small tumour in the inguinal canal, and has a tendency to protrude in the course of the cord, meeting in that direction with the least resistance, and progressively makes its way towards the external ring, having the cord placed behind it; while in this situation, between the two rings and within the inguinal canal, this swelling is termed *bubonocele.* If the swelling can be pushed back into the abdomen, the hernia is called a reducible one, if not, an irreducible one; and, lastly, if vomiting, and the usual symptoms laid down in books of surgery, point out that the intestinal canal in this part is rendered impervious by stricture, then it is called a strangulated bubonocele; and requires, should the taxis and other recommended means fail, an operation; which is performed by laying bare, one by one, the coverings of the protruded intestine: first, the *skin*, in the whole length and course of the tumour; secondly, the *fascia superficialis*, and in this cut a branch of the external epigastric artery is divided, and does sometimes require a ligature; thirdly, the *tendon* of the *external oblique* is split up cautiously, in the same direction as the other incisions: and now the inguinal canal is exposed, and in it the hernial sac, bounded below by Poupart's ligament and cremaster muscle; above, by the free edges of the internal oblique and transversalis muscles, which are separated from the cremaster by the protruding tumour; and behind, by the cord. Before the hernial sac is opened, the surgeon should examine the precise situation of the cord, as it does sometimes happen to be split, so that the vessels may be in front of the tumour, and the vas deferens behind; having ascertained this fact, the *sac* is in the most cautious manner to be opened, and split up upon a director the whole length of the tumour; during which operation, more or less fluid generally escapes. The narrowest part of the tumour is now perfectly exposed, which is called the neck, and which is, in fact, the seat of the stricture, caused by the compression of the internal ring; and, as has been lately discovered by Sir Astley Cooper, is produced by fibres of the transversalis muscle, which passes first from the ilium in front of the cord, winds round it, gets thus behind it, and passes back again to the ilium; thus forming the ring into a complete sphincter muscle, and readily explains, both anatomically and pathologically, the seat and cause of stricture on the intestine, as well as the *rationale* of the effects of bleeding, tobacco, &c., in strangulated inguinal hernia. The stricture is now to be divided by passing a director between the bowel and the sac; or, should there be omentum as well as intestine, it should be placed between the director and bowel, as injury to that membrane is of much less importance than to the intestine; then passing a hernia-knife along the director most cautiously, a slight incision is to be made through the fibres of the transversalis muscle and fascia, in a direction vertically upwards; avoiding the epigastric artery, which is placed just to the inner side of the stricture. The contents of the sac should now be examined with a delicate manipulation, and be returned into the abdomen, or left in the sac, according to circumstances belonging more to the consideration of a surgical than an anatomical writer, and to whom, therefore, I must refer my readers.

The second kind of inguinal hernia is also termed oblique; but besides taking the same course in the direction of the cord, as the last described, passes through the external abdominal ring into the scrotum, and is termed *scrotal* hernia, or *oscheocele.* In the first part of its course, that is to say, while within the inguinal canal, it is precisely in every anatomical consideration the same as the bubonocele; but immediately that it passes through the external abdominal ring, it becomes altered in form as well as acquiring another texture for a covering; but this is not an additional covering, for it loses the tendon of the external oblique muscle, and gains as a substitute the cremaster muscle. This hernia, as it descends into the scrotum, continues in front of the spermatic cord, and descends in old herniæ as low as to the point where the tunica vaginalis testis is reflected from the gland. The tumour is of a pyramidal figure, having the apex situated at the ring; but this apex does not, as it appears, terminate at the external ring, but, as a narrow neck, proceeds upwards and outwards along the inguinal canal to the internal ring; at which point, when this hernia becomes strangulated, the stricture is situated. The steps in the operation to relieve this species of hernia, are the same as those in the preceding kind, excepting that the tendon of the external oblique muscle has not to be divided, in consequence of the tumour having passed through the external abdominal ring; but still it is to be recollected, that there are the same number of coverings to separate, or, I might almost with propriety use the phrase, to peel off the protruded intestine; as it has, in escaping from the inguinal canal, become covered by the cremaster muscle. The intestine being exposed, the stricture,—which is situated as in the other species of hernia at the internal ring,—is to be divided. Why, therefore, is now the question, should not the tendon of the external oblique muscle be split up, and the inguinal canal exposed? The answer is, that, as the hernia protrudes and falls into the scrotum, the weight of intestine, and probably also the action of the transversalis and cremaster muscles, draw the internal ring downwards and inwards so near to the external as to render it unnecessary to open the inguinal canal; indeed, this canal is obliterated by the proximity of the two rings. The situation of the epigastric artery, in relation to the stricture, is the same in both herniæ; and, consequently, the direction of the incision to divide the stricture is similar in each. Such are the circumstances usually concomitant with inguinal herniæ; but the protrusion of part of the intestinal canal through the abdominal rings, are sometimes occurring under varieties which complicate the disease, both in relation to diagnosis and operation. For instance, it does sometimes occur, that the tunica vaginalis is not closed at the internal ring, but that the cavity between the tunica vaginalis testis and reflexa remains open to the cavity of the peritoneum; in which case, a portion of intestine may slip down into the scrotum, within the vaginal cavity, and without bringing with it any other hernial sac. This species of hernia is termed *congenital;* but perhaps, improperly, as it is the tendency to, rather than the disease itself, which is to be considered congenital. There are also encysted herniæ; varieties of situation with respect to the spermatic cord; herniæ which are complicated with hydrocele; diseased testicle; varicocele; and other diseases, which may render the diagnosis difficult. Hernia, therefore, is a subject which requires the greatest attention of the student; and the mind of the surgeon should be particularly directed to the earliest symptoms which pointed out a deviation from health, as well as to the local appearances, to which, however, careful investigation will generally facilitate the means of forming a just diagnosis; and, more especially, as to the precise point where the swelling commenced, which, in oblique inguinal hernia, is invariably at the internal ring, so that the tumour is felt midway between the spinous process of the ilium and pubes, immediately it protrudes; while, on the contrary, hydrocele, diseases of the testicle, &c., commence from the lower part of the scrotum.

There is yet another species of inguinal hernia, and which differs essentially from the oblique, from not passing through the internal ring, and from being placed on the inner side of the epigastric artery; on which account, it is sometimes called *internal* inguinal hernia; or *ventro* inguinal, from passing directly from the cavity of the abdomen through the external ring; but, more frequently, *direct* inguinal hernia, in contradistinction to the oblique, from passing perfectly straight from the abdomen, and not taking the course of the cord. If the tumour in this hernia be large, it is difficult to tell it from an oblique hernia; for the intestine meeting with least resistance outwards, the tumour appears to take an oblique direction: but should the intestine become strangulated, so as to render an operation necessary, one of the coverings peculiar to this rupture at once points out the nature of the disease. This covering is the tendon formed by the internal oblique and transversalis muscles, which passes behind the external ring to be inserted into the pubes, and is necessarily protruded with the intestine, as well as the portion of the fascia transversalis, which is connected with it. This is the only hernia which protrudes with a tendinous covering through the external ring; and therefore, when this structure is found, the nature of the disease is at once known; and the division of the stricture, as in the preceding species of hernia, may be made directly upwards: thus avoiding the epigastric artery, which is on the outer side of the neck of the sac.

Femoral, or *crural hernia*, is distinctly different from those already described, in not passing through either of the rings, but protruding from underneath Poupart's ligament, and forming a tumour upon the upper part of the thigh; therefore it becomes necessary to describe the parts upon the upper region of the thigh, which are connected with this hernia, before it can be comprehended. On removing the skin from the anterior part of the upper third of the thigh, we bring into view the superficial fascia, which has been already alluded to as a continuation of the aponeurosis of the external oblique; and immediately below Poupart's ligament it divides itself into layers enveloping the superficial inguinal glands, and binds them firmly down to the subjacent structure. On removing this fascia and the glands, we expose the fascia lata, a strong aponeurosis giving more intimate covering to the muscles of the thigh. It takes its origin by two distinct portions, which very much resembles the mode by which the transversalis fascia terminates, each leaving an open space between the two portions. The outer, or iliac portion of the fascia lata, arises from the whole extent of Poupart's ligament, passes downwards upon the thigh, presenting a concave or cresentic edge facing inwards, which, on the outer side, slightly overlaps the sheath of the femoral vessels, and terminates from an inch to an inch and a half below Poupart's ligament by joining the pubic portion. (*Vide Plate* I. 4, 4, 4.) The pubic portion proceeds from the spinous process of the pubes from Gimbernat's ligament and linea ilio pectinea, and from Poupart's ligament; situated on a plane posterior to the other, it passes down upon the inner side of the thigh, covering the pectineus muscle, proceeds outwards as far as the femoral sheath (*Vide Plate* I. 5, 5, 5.); there splits into two layers, one of which passes posterior to the sheath, becomes connected with the fascia iliaca and capsular ligament of the hip-joint; the other, passing anterior to the vessels, joins the outer or iliac portion of the fascia lata, as mentioned above: thus a foramen is completed, which admits the termination of the saphena major vein into the femoral vein. Through the whole course of the inner side of the thigh this vein is found external to the fascia lata, between it and the superficial aponeurosis, until it becomes lost at this point; below which the two portions of the fascia form one uninterrupted aponeurotic expansion. The edges of the cresentic opening are rendered indistinct by a process of fascia which connects them with Poupart's ligament; this portion allows the passage of absorbent vessels from the superficial to the deep inguinal glands, and is by some anatomists termed the middle portion of fascia lata; until this is removed, neither the crescentic opening or the sheath of the femoral vessels are brought fairly into view.

It is now only necessary to describe the parts connecting the abdominal cavity with the thigh.

We have already adverted to the mode in which the thigh is connected to the abdomen by means of the different structures which pass under Poupart's ligament; namely, the psoas iliacus and pectineus muscles, the crural nerves, femoral artery, vein and absorbents. Gimbernat's ligament also assists in diminishing the size of the arch, and may be said to form its inner boundary. As regards the relative situation of these structures, the muscles will be found immediately applied to the bony margin of the pelvis; and lying on them we shall see the femoral artery in the centre, having to its outer side the nerve, to its inner the vein. To the inner side of the vein, between it and Gimbernat's ligament, is a small space apparently filled up by cellular membrane and soft adipose structure, but which transmits the absorbents from the thigh into the abdominal cavity. It now remains to be shewn, how the passage of the artery, vein and absorbents are secured by the adaptation of two fasciæ; the one derived from the anterior, the other from the posterior abdominal parietes: both of which descend with the vessels under Poupart's ligament; and, contracting around them, prevent, under ordinary circumstances, the protrusion of the abdomial viscera through the same opening. One of these membranes, the fascia transversalis, has already been described as forming the immediate anterior abdominal parietes, and dividing into two portions—the external attached to Poupart's ligament, the internal passing into the thigh, and covering the crural vessels. This last portion, in its descent, is extended inwards beyond the femoral vein as far as Gimbernat's ligament, to which it is attached. The second membrane is called the fascia iliaca, and is situated in the iliac fossa; commencing at the inner labium of the crista of the ilium, and extending downwards towards the crural arch, covering the iliacus and psoas muscles. It thus lies immediately behind the peritoneum, and consequently forms the posterior abdominal parietes. Having reached the line between the spinous processes of the ilium and pubis, the fascia iliaca terminates on the outer side by being inserted into the external half of Poupart's ligament, in common with the corresponding portion of fascia transversalis; while on the inner, it descends into the thigh behind the femoral vessels, and thus constitutes the posterior layer of their sheath. It is also attached, in common with the fascia transversalis, to Gimbernat's ligament; and the sheath is completed by the junction of the two membranes on either side of the vessels. By this arrangement it will be understood, that the outer half of the crural arch is perfectly secured by the junction, or common attachment to Poupart's ligament, of the two membranes derived from the anterior and posterior surfaces of the abdomen; while on the inner half, an elliptical opening is left communicating with the thigh, and occupied by the vessels together with the same membranes, descending before and behind them, forming their sheath. It is this sheath, which is seen through the cresentic opening of the fascia lata, partly overlapped by its external edge and lost to view below, where the two portions of the aponeurosis join. In shape it resembles a funnel, being wide above where it emerges from under Poupart's ligament, and becoming suddenly contracted around its contents as they descend into the thigh. This contraction is particularly abrupt on the inner side, so that the fascia transversalis appears to extend almost transversely from Gimbernat's ligament to the outer side of the femoral vessels. On opening the sheath the artery will be found separated from the vein by a slight process sent down between them. On the inner side of the vein are situated the deep-seated absorbents of the lower extremity: some of which are continued upwards into the abdomen, while others pierce the sheath to reach the inguinal glands. From this latter circumstance the name of fascia cribriformis has been given to that portion of the fascia transversalis which covers the inner side of the vein, and extends from it to Gimbernat's ligament. It is altogether of a looser and more yielding texture, rendering it occasionally insufficient to prevent the descent of a femoral hernia; for, from the foregoing description, it will be manifest, that any portion of the abdominal viscera, making its escape by the side of the vessels, must be opposed in its progress by their sheath. The opening which allows the passage of a crural hernia under Poupart's ligament, is that occupied by the absorbents on the inner side of the vein: it is called the femoral or crural ring; and is bounded on the outer side by the vein, on the inner by Gimbernat's ligament, before by Poupart's ligament lined by fascia transversalis, behind by the pubes covered by fascia iliaca. Into this opening the finger may readily be insinuated from the abdominal cavity, especially when the peritoneum is removed; but its progress downwards towards the thigh is checked by coming in contact with the fascia cribriformis extending, as it were, across the opening from the femoral vein to Gimbernat's ligament. This resisting structure, however, gradually yields before the pressure of a hernia, until at length the fascia cribriformis, together with a quantity of loose cellular tissue which assists in filling up the ring, becomes dilated into a pouch, which contains the peritoneal sac; and, projecting through the crescentic opening of the fascia, is immediately subjacent to the superficial aponeurosis. Thus although the hernia, while passing under Poupart's ligament, is contiguous with the femoral vein, it becomes immediately received into, or, more properly, forms for itself a distinct cavity, derived from the sheath which it dilates before it. The covering which a hernia thus acquires, is frequently denominated the fascia propria.

The first external appearance indicating the presence of an incipient femoral hernia, is that of a tumour situated immediately below and rather to the outer side of the spinous process of the pubis, becoming, in its progress, larger and more superficial as it rises through the opening of the fascia lata. Its coverings will be found to be three in number, exclusive of the peritoneal sac: these are, first, the common integuments; and under it the superficial aponeurosis, probably involving one or more of the inguinal glands; on removing this we discover the third tunic, or fascia propria, which is always loaded, and consequently obscured, by more or less adipose structure. On dividing this last covering, the peritoneal sac will be brought into view. A crural hernia, however, does not always occupy the situation which has been described; for, as it increases in size by the successive escape of fresh portions of viscera, it will be found to take a direction upwards, turning over Poupart's ligament, and resting on the tendon of the external oblique muscle of the abdomen. The explanation of this apparently unnatural course, appears to consist in the firmness with which the superficial aponeurosis adheres to the crescentic edge of the fascia lata, together with the presence of the absorbent glands, whereby the hernia is prevented from descending into the thigh: while, at the same time, the looseness of the cellular tissue covering Poupart's ligament offers little mechanical resistance to its passage in that direction.

The situation assumed by a hernia is of the utmost importance: since the principles by which we attempt its reduction are founded upon a knowledge of the course which it pursues.

When the intestine is strangulated in femoral hernia, an operation must be performed to relieve it. The first incision through the integuments is made in the form of a reversed ⅃; the angles of the integument being then dissected upwards, the fascia superficialis is exposed; this fascia being reflected in the same manner, the fascia propria or fascia transversalis or the anterior layer of the sheath of the vessels comes into view—these three names all meaning the same covering to the hernia, and derive their different appellations from various authors; but it is to be remembered that it is, under each or all these names, the pubic portion of the fascia transversalis passing down from the abdomen on to the thigh. This being removed, the hernial sac presents itself; or, very frequently, a considerable quantity of fat covers it, and which may lead to some difficulty unless the surgeon is aware of the frequency of the existence of fat in that situation. The sac should now be most carefully opened, and more than usual precaution is required; first, because in a femoral hernia but a very small quantity if any fluid is found in the sac; and, secondly, because the protruded part is frequently a portion of intestine only, without omentum. The seat of stricture is now the object of the surgeon's attention; and, indeed, much variety of opinion exists as to this important subject:—some surgeons being of the opinion, that Gimbernat's ligament is the cause of strangulation; others, that it is Poupart's ligament; while Sir Astley Cooper contends it is at the neck of the sac, at the crural ring, where the constriction exists; and that the division of the fascia propria in a direction upwards and slightly inwards, will immediately liberate the intestine and divide the stricture. My experience would certainly lead me to the conlusion, that the division of Gimbernat's and Poupart's ligaments would never liberate a femoral hernia, unless the fascia propria was divided at the crural ring in the manner as recommended by Sir Astley Cooper.

There are varieties with respect to the origin of the obturator artery which complicate the division of the stricture in this hernia; and I therefore recommend the student to consult treatises on this subject, with peculiar caution; and can recommend Sir Astley Cooper's and Mr. Lawrence's works, as entering deeply into this subject, and describing in detail all such surgical points as render the operation comparatively easy to an anatomist.

Wounds and Injuries of the Abdomen,

Are also subjects which should be particularly attended to; as the effects of them are frequently fatal, although there may appear to be but little external signs of violence.

They may be divided into the following classes :—

First.—Where the parietes only are injured, without the peritoneum being affected.

Secondly.—Where the peritoneal cavity is laid open, but without injury to the abdominal viscera.

Thirdly.—Where the abdominal viscera themselves are also injured, either by the instrument inflicting the wound, or from their protrusion through it.

Fourthly.—Where the viscera themselves are lacerated, producing extravasation of their contents into the cavity of the abdomen without external injury.

Each of these divisions are marked by symptoms peculiar to themselves, and require distinct treatment; subjects which are too lengthened, however, to permit an anatomical writer to treat of.

LECTURE XIV.

DESCRIPTIVE ANATOMY OF MUSCLES.

The Muscles of the Exterior of the Cranium and the Face.

BEFORE I enter upon a minute description of these muscles, it is requisite to point out those circumstances in which, with respect to their functions, they differ from all the other muscles of the human body: namely, that during their contraction, they draw the integuments by which they are covered in various directions, without producing any change of position in the osseous parts to which they are attached.

There are thirteen pairs and a single muscle included in this classification; of which the three sphincter muscles, denominated *orbiculares*, are the principal, being for the purpose of opening and closing the eyes and mouth; the rest being employed to moderate and assist them in their action.

When the three orbicular muscles act, their edges are brought in contact; while, laterally, they are held from the centre by their attachments, and the moderating muscles, with their cutaneous coverings, are drawn towards the centre: when the orbicular muscles are opened by the contraction of their moderators, the skin covering them is made to radiate, as from a centre towards the circumference of a circle. In the special description it appears consistent to commence with the principal muscles, the orbiculares, and then to proceed with the description of their respective moderators, or the muscles which are subservient to their actions.

The *m. orbiculares palpebrarum.*—A circular incision around the bony edges of the orbits will expose these museles; the fibres of whieh are thin and pale, and are found completely surrounding the orbits, and extending into the fibro-eartilages of the eyelids. They *arise* from the internal angular proeess of the os frontis, and from the groove which lodges the lacrymal sac in the superior maxillary bone; and also by a small tendon which attaches the tarsi of the eyelids to the nasal process of the same bone; from these origins the fibres spread outwards along the upper and lower margins of the orbit, and unite at the outer canthus, being there very loosely conneeted to the bones by eellular membrane. They are united above, to the m. oecipito frontales and eorrugatores supereiliorum; below, a few fibres are eonnected with the skin of the cheek. The pale straight fibres of these museles, whieh are forming a part of the eyelids, are sometimes deseribed as separate museles, under the name of musculi ciliares.

Use.—To close the eyelids and to compress the globe of the eye, and direct the tears from the outer towards the inner canthus. They draw the integuments downwards from the cranium, upwards from the lips, and inwards from the temples. Their most fixed point is at the internal angular process of the frontal bone; towards which their superior fibres are drawn in frowning, by the action of the musculi corrugatores superciliorum.

The muscles which moderate and assist in the action of the museuli orbiculares palpebrarum are the m. occipito frontales, the levatores palpebrarum superiorum, the eorrugatores superciliorum, and the depressores labii superioris alarumque nasi.

If the fibres whieh form the eonnection between the m. orbieulares palpebrarum and the occipito frontales be raised from the inner eanthi, the *musculi corrugatores superciliorum* will be exposed; which are small museles *arising* from the internal angular process of the frontal bone; from which origin they pass upwards and outwards, as far as the centre of the superciliary ridge, to be *inserted,* by forming an interlacement with the musculi orbiculares palpebrarum and the occipito frontales.

Use.—To draw inwards the skin and to elevate the hair of the eyebrows, expressing the passions of malevolence and anger.

The *m. occipito frontales.*—To expose these muscles an incision should be made on either side, transversely from the mezian line to the external angular process of the frontal bone; and a second incision commencing at the tuberosity of the occiput, and terminating at the nasal process of the os frontis. The teguments of the cranium should now be very cautiously reflected, for they will be found very dense and adhering firmly to the muscle and tendon beneath. The m. occipito frontales are fleshy anteriorly and posteriorly, and tendinous on their superior and lateral surfaces, covered throughout by a thick rough subcutaneous cellular tissue, by which they are firmly connected with the skin, and lying upon the pericranium. They *arise* posteriorly from the superior transverse ridge of the occiput, reaching outwards as far as the mastoid processes of the temporal bones; their fleshy fibres proceed upwards and forwards to the lambdoidal suture; then becoming tendinous, expand over the vertex of the cranium as far as the coronal suture; there again becoming fleshy, pass downwards to be *inserted* into the skin of the eyebrows, and to be connected with the m. orbiculares palpebrarum and corrugatores superciliorum, sending a fleshy slip downwards on the dorsum of the nose to join with the m. compressores narium.

Use.—To explain this it is necessary to divide these digastric muscles into their occipital and frontal portions. The frontal portions bring forward the skin of the forehead, at the same time wrinkling it transversely; and also assist in raising the upper eyelids, while the occipital portions draw backwards the skin of the head; and both put the central aponeurosis upon the stretch. These muscles may be considered as forming a distinct digastric muscle on each side of the head, as is proved by their single action during the winking of either eye.

The last muscles to be described as moderating the action of the orbiculares palpebrarum, are

The *m. levatores palpebrarum superiorum,* which, although not easily exposed at this stage of the dissection, cannot with propriety be omitted in this classification; although they must be again mentioned when describing the muscles situated within the bony orbits. These muscles *arise* from the superior edge of the foramen opticum of the sphenoid bone, proceed forwards upon the under surface of the orbitar process of the frontal bone, and becoming larger anteriorly are *inserted,* thin and tendinous, into the tarsus of the upper eyelid.

Use.—These muscles are passing from behind to before, describing a curve, the convexity of which is turned upwards, corresponding to the form of the ball of the eye, which form enables them to raise the eyelids; they also moderate the actions of the upper ciliary portions of the orbiculares palpebrarum, acting alternately with them, and preserving the moisture and transparency of the cornea, and protecting it from dust and strong reflections of light.

The third orbicular muscle surrounds the opening of the mouth, and is termed, therefore, the *orbicularis oris.* It is composed of two portions of circular fleshy fibres which pass around the lips, decussating each other on either side, and freely intermixing with the insertions of the muscles which moderate its actions, and which tend in a great measure to form it. This muscle is covered anteriorly by the integuments, and posteriorly is in contact with the lining mucous membrane of the mouth and lips; it is not attached to bone; immediately beneath the skin a considerable quantity of fat is mixed with its fibres, which are free from it posteriorly.

Use.—To close the mouth by bringing the lips in contact; by the action of the muscles intermixed with it, the mouth is opened; and by the alternate action of this sphincter and its moderators, the countenance is furnished with means of expressing all the varieties of emotion and passion.

The muscles which are employed in assisting and moderating the action of the orbicularis oris are ten pairs, and are situated around the opening of the mouth in the following order:—

Four pairs above the upper lip, three pairs by the side of the mouth situated on the cheek, and three pairs below in connexion with the lower lip.

Those above are the m. compressores narium, levatores and depressores labii superioris alarumque nasi, and the levatoris anguli oris.

Those by the side, the m. buccinatores and zygomatici.

And, those below, the m. levatores and depressores labii inferioris, and the depressores anguli oris.

Before describing the origin and insertion of these muscles, it is right to point out the reciprocal action of the upper lip, and moveable parts of the nose, in the function of respiration; and we shall find, that three out of the four pairs of the muscles situated above the upper lip, produce a change of position in the cartilages of the nose and give motion to the lip simultaneously; and therefore may be considered as equally belonging to the nose and mouth.

The *musculi compressores narium*, although usually described as proper to the nose, are common to the nose and mouth; and hence must be classed as moderators to the orbicularis oris. They *arise* above from the dorsum of the nose, being there connected with some fibres of the occipito frontales; they then diverge, pass downwards and outwards on the sides of the nose, and are *inserted* by being connected with the fibres of the levatores and depressores labii, superioris alarumque nasi, and cartilages of the nose.

Use.—To moderate the actions of the occipito frontalis and orbicularis oris; they are made to dilate or compress the nares, according to the preponderating action of the levatores, or depressores labii, superioris alarumque nasi.

The *m. levatores labii superioris alarumque nasi, arise* by two portions from the superior maxillary bones; one from the nasal process, the other from the anterior part of the bone between the inferior ridge of the orbit and the infra orbitar foramen; extending as far outwards as the malar bone. From these points of origin the fibres pass downwards in two fasiculi, which converge: the inner fasciculus passes to be *inserted* into the ala nasi and upper lip; while the outer one passes into the lip only, intermixed with the orbicularis and levatores anguli oris. The distinctness of the two fasiculi has led some anatomists to describe each as a separate muscle.

Use.—Their individual use is to raise the upper lip and alœ of the nose, producing the expression of contempt; but they are more frequently used as moderators to the orbicularis oris.

The *m. depressores labii superioris alarumque nasi,* are small muscles situated behind the lips, and are not exposed until the mucous membrane of the mouth is removed from the upper jaw: they *arise* from the superior maxillary bones from a small fossa just above the alveolar processes of the incisor teeth; they pass upward towards the posterior region of the wing of the nose, into which they are partly *inserted;* the rest of their fibres intermixing with the last described muscles and the orbicularis oris.

Use.—To depress the wing of the nose and upper lip, and assist in closing the nares.

The *m. levatores anguli oris,* arise from the depression below the infra orbitar foramen on the superior maxillary bone, being covered by the external or malar origins of the levatores labii superioris alarumque nasi; they pass downwards and outwards to be inserted by interlacing with the fibres of the orbicularis oris, and those muscles forming the angles of the mouth.

Use.—To raise the corners of the mouth upwards and inwards.

The *m. zygomatici,* are two small pairs of muscles embeded in a considerable quantity of fat, and extending across the cheek to the angles of the mouth.

The *m. zygomatici majores,* are situated externally and posteriorly to the zygomatici minores; they *arise* near the posterior angle of the malar bones, pass downwards and inwards crossing the buccinatores, from which however they are separated by a considerable quantity of fat, and are *inserted* into the corners of the mouth, uniting with the orbicularis oris, and its lateral moderators; each muscle sometimes bifurcates so as to be connected with both lips at its insertion.

The *m. zygomatici minores,* are sometimes wanting; when present they *arise* on the inner side of the last described muscles from the malar bone; and passing down in the same direction, are *inserted* by joining with the fibres of the orbicularis oris and levatores labii superioris.

Use.—The zygomatici raise the corners of the mouth backwards and outwards, and thus produce the expression of joy and laughter.

Beneath the zygomatici, and covered by a considerable quantity of fat, are placed

The *m. buccinatores;* these muscles are thin and square, forming the muscular part of the cheek, and occupy the lateral space between the superior and inferior maxillary bones; they *arise* posteriorly from a ridge between the last molar tooth and the coronoid process of the lower jaw; also from the upper jaw between the last dens molaris and the pterygoid process of the sphenoid bone, from which they partly arise, as well as from the pterygoid process of the palate bone; in this situation being connected with the superior constrictor of the pharynx.

From these origins their fleshy fibres pass forwards to be *inserted* into the angle of the mouth; at the point of insertion decussating, so that the upper fibres pass to the lower lip, and the under ones to the upper, interlacing with the orbicularis oris. The cutaneous surface of these muscles is covered by the zygomatici muscles and fat, and traversed by the excretory duct of the parotid gland, which obliquely perforates it opposite to the third molar tooth. The internal surface of these muscles is lined by the mucous membrane of the mouth.

Use.—To draw the corners of the mouth backwards, and to assist in the process of mastication, by compressing the cheeks and keeping the food between the teeth; and further, in blowing wind instruments, they economise the air which is contained within the mouth.

The last set of muscles to be described as moderators to the orbieularis oris, are the three pairs situated upon the ehin below the opening of the mouth.

The *m. levatores labii inferioris,* are situated in a similar manner with respeet to the lower lip that the depressores are with the upper, being plaeed between the mueous membrane of the mouth and the lower jaw. They *arise* just below the alveolar proeesses of the ineisor teeth of the inferior maxillary bone; the fibres diverge as they pass downward to be *inserted* into the inner surface of the lower lip and the skin of the ehin.

Use.—The use of these muscles is to raise the skin of the chin and lower lip in a direction inwards and backwards, so as to cover the teeth of the lower jaw.

The *m. depressores labii inferioris.*—To expose these museles some of the attenuated fibres of the platysma moyides must be raised; they are flat and broad museles, arising from the anterior and lateral parts of the inferior maxillary bone, extending as far outwards as the origin of the depressores anguli oris, and eontinue as far forwards as the middle line, where the musele of eaeh side approximates; from this attaehment they pass upwards, their anterior fibres vertieally, their posterior with obliquity inwards, to be *inserted* into the under lip, and to be eonneeted with the orbieularis oris.

The depressores anguli oris partly cover the outer origin of these museles.

Use.—To depress the lower lip.

The *m. depressores anguli oris,* are situated on the outer side of the last described museles; their form is triangular, gradually diminishing in breadth from their origin to their insertion. They *arise* from the sides of the inferior maxillary bone, a little above its base, from a line extending from the root of the coronoid process to the anterior maxillary foramen, and pass upward to be *inserted* into the eorner of the mouth, uniting with the zygomatiei orbieularis oris and buccinatores. They are covered by the integuments and platysma myoides, and partly cover the buccinatores and depressores labii inferioris.

Use.—To depress the angle of the mouth, and to assist the last described muscle in producing the expression of grief.

Having concluded the anatomical description of the muscles situated on the exterior of the cranium and face, I am desirous of detailing their physiological relations, in such a manner as to convey a conception of their multiplied and varied actions as connected with the function of respiration, and with the physiology and theory of expression. In the first place it will be remembered, that of the muscles of the face three are orbicular, surrounding the eyes and the mouth; and that the rest may be regarded as varying and modifying the direction of their action: and, secondly, that the muscles of the face are peculiar in moving the integuments; while the osseous parts beneath remain fixed. Bearing in mind these two facts, we shall find a ready explanation of all the modifications of their action and expression; whether induced by natural, excited, or impeded respiration, or by the feelings and passions of the mind. I would however observe, that notwithstanding all that has been said on the subject of physionomical expression; notwithstanding the many learned disquisitions that have been entered into, respecting the influence of feeling and passion upon the countenance; more mystery has, I think, been thrown over the subject, than it will, on a minute and careful examination, be found to deserve. We know that the expression of countenance in one whose respiration is greatly hurried or much impeded, is sufficiently explained by the consideration of the action of those muscles which are necessarily called into action by the increased necessity for their exertion. In this case, at least, the mere anatomical explanation is satisfactory, as to the expression; but in other instances, where certain passions or emotions are expressed, the connection between the passion or emotion, and the expression of countenance, is less obvious: and hence it is, that we are for the most part content with the fact, without attempting to explain it. Upon the whole, however, I am disposed to conclude, that even in these cases, if not indeed in every case, a minute attention to the state of respiration will afford the true solution; or, in other words, that as in the expression of countenance indicative of, and produced by, an obviously hurried or impeded respiration; the modifications of the countenance, expressive of the various passions and emotions, may be traced to a certain state or condition of the muscles of expression called into existence by their subserviency to respiration,—that function being influenced by the particular emotion; the association being such as anatomy and physiology sufficiently explain.

Be this as it may we know, at least, that during any violently excited respiration, the chest becomes expanded, the shoulders raised, the mouth and nose opened, and the whole countenance thereby pourtraying a certain consequent expression; whilst any mental or morbid corporeal cause impeding respiration, has also its corresponding expression. Thus in grief, which may be fairly taken as an instance of impeded respiration, we find that the visage undergoes a change which marks the peculiar passion; and the expression of the face characterises the inward sensation, by its contracted state: the eyebrows approach each other, the mouth is drawn down, and the nose becomes pinched so as to diminish the size of the external openings; at the same time the chest is flattened, and its slowly alternating elevation and depression, with the occasional sigh or sob, sufficiently indicate an impeded respiration. While in the expression of joy, on the contrary, the whole countenance is lighted up, the eyebrows and eyelids are raised; the alœ of the nose and angles of the mouth are drawn upward; and the playful motions of the mouth denote the necessity of a corresponding change of form with the state of the lungs, which breathe with a freedom marked by the quickened elevation of the chest, and the occasional laugh, which is but a succession of frequent expirations. These passions in the best possible manner denote the reciprocal action of the muscles of respiration and of the face; and as we advance further in the knowledge of anatomy, it will be found that the distribution of the nerves, as has been demonstrated by Mr. Charles Bell, corresponds with the phenomena related.

Practical Remarks.

It is obvious from the various functions to which the muscles of the exterior of the cranium and the face are subservient, and from the manner in which they are destined to move their cutaneous coverings, that in the treatment of all wounds to these parts, the surgeon should most studiously endeavour to diminish their motion, by keeping the edges of the wound in apposition with sutures, plaisters, and bandages; and, as has been stated, that respiration, modified by the passions, is the natural stimulus to these muscles,—physiology and pathology point out to us the propriety of warning our patients to avoid every mental excitement; for, in proportion as parts are subjected to motion, so is the adhesive inflammation disturbed, and a tendency to the suppurative promoted. Thus we find, that superficial wounds of the scalp become of serious importance in consequence of the frequent motion of the occipito frontales muscles; a danger which is much enhanced if the tendon of these muscles be wounded, not only from the motion, but also from the little power that structure possesses of reparation, suppuration and erysipelas frequently supervene: it is therefore essential in operations on the scalp, to avoid wounding this tendon.

Wounds about the orbits are subject to the same disturbance, from motion during their reparation, as the other parts of the head and face, and require, therefore, the same means to keep their edges in adaptation. Such injuries, however, are more serious, on account of the important function these parts have to perform; for should they interfere with the action of the orbiculares palpebrarum, the organ of sight itself may be affected by the diseases called ptosis, or lagopthalmos: in the former, the upper eyelid hangs down over the eye, caused by a disturbance to the adhesive inflammation, or paralysis to its nerve of motion; while, in the latter, the eyelid is drawn permanently upwards by a contraction of the cicatrix, so that the cornea is constantly exposed. It is said, that injury to the supra orbita nerve sometimes produces amaurosis; but there is reason to suspect the validity of this opinion, as the function of this nerve cannot, in any way, be traced as further necessary to vision than as destined to supply the tutamina oculi; and its division could therefore only indirectly and slowly affect sight. I am disposed to believe, that where amaurosis follows this accident, it is produced by the concussion of the optic nerve, and not in any way attributable to injury of the supra orbitar.

Wounds of the cheek are frequently productive of serious consequences, from injury to the parotid duct, attended with a constant flow of saliva, and producing a fistulous opening: but on this subject I shall treat more particulary when speaking of the salivary apparatus; only now recommending the early and perfect adaptation of the edges of the wound.

Muscles superficially situated on the anterior part of the Neck.

The neck is that part of the trunk situated between the thorax and cranium; it is divided into an anterior and posterior surface, each giving attachment to muscles: and those of the anterior region are now to be described. This region is bounded superiorly by the inferior edge of the lower jaw, and mastoid processes of the temporal bones; inferiorly, by the sterno clavicular articulations, and the upper surfaces of the clavicles; and laterally by the anterior edges of the musculi trapezii, extending from the posterior part of the mastoid processes to the acromial extremities of the clavicles. In the median line of this region, the larynx is seen to project, and on either side of this projection the course of the sterno cleido maistoideus muscle is observed through the skin and platysma myoides, converging inferiorly and diverging in the upper and lateral regions; between the posterior edge of the sterno cleido mastoideus, and the anterior edge of the musculus trapezius, is a triangular depression, the base of which is formed by the clavicle. The muscles situated in the anterior part of the neck are numerous; but their dissection will be facilitated by taking them in the following order:—First, those which are superficially situated; secondly, those which fix the os hyoides; thirdly, those which depress the lower jaw; fourthly, the muscles running transversely from the temporal bone to the os hyoides; and, lastly, those which are deeply-seated on the vertebral column.

In commencing the dissection of the muscles superficially situated, an incision should be made through the skin only, from the symphisis of the lower jaw to the centre of the clavicle; one portion of the skin is to be reflected forwards, and the other backwards; and thus a condensed fibro-cellular tissue, which has received the name of the *fascia superficialis,* is exposed. This fascia is continuous above with the fascia which covers the parotid gland; inferiorly it extends upon the thorax, there being continuous with the superficial fascia of the chest and abdomen; while on the neck it presents one continuous sub-cutaneous surface; but its muscular or deep surface sends off processes which pass down between the muscles to join the fascia cervicalis profunda, and give a complete covering to many of them. At the anterior edge of the trapezius muscle, it becomes attenuated and sends off a layer which passes beneath the platysma myoides so as to inclose it. The situations in which the superficial fascia is most firmly connected with the deep fascia, are above, between the angle of the jaw and styloid process of the temporal bone; and, below at the upper edge of the sternum, between the origins of the sterno cleido mastoidei. The fascia superficialis is now to be dissected from the neck, to expose

The *musculus platysma myoides,* which is a thin quadrilateral muscular expansion, situated on the anterior and lateral parts of the neck; it *arises* inferiorly from the cellular membrane covering the m. pectoralis major and deltoides; its fibres are at its origin separated from each other, but they gradually approximate as they ascend obliquely upwards and inwards to the basis of the inferior maxillary bone, to which they are attached; and then passing over the inferior part of the cheek *intermix* with the muscles of the face, and more especially with the depressores labii inferioris et anguli oris. It is inclosed within two layers of the superficial fascia, at the chin, being united with its fellow, but separated below, leaving a space where the fasciæ unite with each other, forming a dense resisting membrane. The external jugular vein takes its course beneath the platysma myoides, passing to the lower and clavicular origin of the sterno cleido mastoideus, to terminate in the subclavian vein, being situated between the superficial and deep fasciæ of the neck.

Use.—This muscle assists in depressing the lower lip and corners of the mouth, wringles the skin of the neck transversely, assists in depressing the lower jaw, and may be said in some measure to assist also in the motions of the head.

On removing the platysma myoides muscle, the *fascia cervicalis profunda* should now be traced to its attachments. It forms a dense aponeurotic expansion, and proceeds as a continuation of the ligamentum nuchæ around the neck. Above it is attached to the lower jaw, being connected there with the pterygoideus internus muscle, and passing downwards and backwards to the styloid process of the temporal bone, forming the stylo maxillary ligament, which separates the submaxillary from the parotid gland. It proceeds from this point forwards to the anterior edges of the sterno cleido mastoideus, and there becomes connected with the superficial cervical fascia; it then continues forwards to the mesian line; in its course above, giving a covering to the submaxillary gland and muscles, between the os hyoides and lower jaw; below, to the larynx and trachæa; and sends off processes to the muscles in the neighbourhood of the larynx, which pass deeply between them, so as to form sheaths around them; it then descends connected laterally with the anterior edges of the sterno cleido mastoidei to the sternum, where it divides into two layers; the anterior, being subcutaneous, to be connected with the superficial fascia; while the deep one, which had invested the omo hyoideus muscle, passes to surround the m. subclavius, from the anterior edge of which it passes to the corocoid process of the scapula, and to the anterior surfaces of the two superior ribs; being in this situation so firm as to have received the name of costo coracoid ligament. This ligament is highly important from giving a covering to the subclavian artery and vein, in the space precisely corresponding to the division between the sternal and clavicular portions of the m. pectoralis major. From the posterior edges of the sterno cleido mastoidei, this fascia proceeds downwards upon the chest, and becomes connected with the superficial cervical fascia.

The *m. sterno cleido mastoideus.*—This muscle is exposed by the removal of the deep cervical fascia. It is a thick fleshy muscle, about two inches in breadth, situated in the anterior and lateral parts of the neck, which it divides into an anterior and posterior region. This muscle *arises* by two distinct portions ; the inner origin is thick and tendinous, arising from the upper and anterior part of the sternum, passes upwards and backwards, and meets the outer origin, which arises aponeurotic from the upper part of the sternal extremity of the clavicle,—a space being left between these two origins of a greater or less extent in different subjects, which is filled up with cellular membrane. The muscle then proceeds upwards and backwards to be *inserted* superiorly by thick aponeurotic fibres into the mastoid process of the temporal bone, and the external third of the superior transverse ridge of the occiput.

The sterno cleido mastoideus is covered by the deep cervical fascia and the platysma myoides: inferiorly it lies upon the sterno hyoid and thyroid muscles, and the sheath of the carotid artery and internal jugular vein ; it crosses over the omo hyoideus, separated by it from the scalenus anticus muscle ; and at its insertion it is immediately in contact, posteriorly, with the trachælo mastoideus, and anteriorly with the parotid gland.

Use.—To rotate the head in co-operation with other muscles; the sterno cleido mastoid of the left side, co-operates with the platisma myoides of the right, in performing the rotatory motion to the right; and *vice versa.* It also assists in violent inspiration, and is therefore to be considered as an antagonist to those muscles which depress the sternum. Its directions of action are downwards towards the sternum, and inwards towards the mesian line.

The muscles which are next to be dissected in the anterior region of the neck, are those which fix the os hyoides ; they form a fixed point for the action of the muscles placed between the os hyoides and lower jaw, which is necessary to enable them to open the mouth.

Four pairs of these muscles are placed below the os hyoides, between that bone and the trunk; but the fifth pair belong to the fourth class of the muscles on the anterior part of the neck, and are found placed between the styloid process of the temporal bone and os hyoides, for the purpose of preventing the os hyoides being tilted too much forwards by the action of the other muscles.

To commence this dissection, the sterno cleido mastoideus should be divided near its centre, and turned towards its attachments, when a narrow muscle will be seen passing vertically from the os hyoides to the sternum, called

The *m. sterno hyoideus.*—It *arises* inferiorly, by three distinct origins, from the back part of the sternum, from the posteror sterno clavicular ligament, and from the cartilage of the first rib; it then descends as a narrow band of muscular fibre, with a slight obliquity upwards and inwards, converging towards its fellow to be *inserted* into the lower edge of the body of the os hyoides. This muscle is covered by the deep fascia of the neck, and at its origin by the sterno cleido mastoideus; it covers the sterno thyroid, the crico thryroid and thyro hyoid muscles; and in passing in front of the larynx, a small bursa is usually found beneath it.

Use.—To depress the os hyoides and larynx, and secondarily assists in the depression of the lower jaw.

The *m. sterno thyroideus.*—This is brought into view by dividing the former muscle and reflecting it towards its attachments; it *arises* from the posterior and upper part of the sternum, rather to the inner side and with a broader origin than the sterno hyoideus, and also from the cartilage of the first rib; it then proceeds upwards to be *inserted* into an oblique line extending across the ala of the thyroid cartilage. This muscle is covered at its origin by the sterno cleido mastoideus; throughout its whole length it is behind the sterno hyoideus, but which does not entirely conceal it, in consequence of its greater breadth; it is also enveloped by a process of the deep cervical fascia; at its origin it has behind it the internal jugular and subclavian veins, and on the right side also the arteria innominata: it then runs upwards upon the trachæa, and its outer edge partly overlaps the carotid sheath; it afterwards lies upon the thyroid gland and crico thyroideus muscle.

Use.—It depresses the os hyoides, larynx and thyroid cartilage; and by the motion which it gives to the latter, modifies the voice by stretching the vocal chords.

The *m. thyro hyoideus*—*arises* from the oblique line upon the ala of the thyroid cartilage, immediately above the insertion of the last described muscle, so as to appear continuous with it; and passes directly upwards to be *inserted* into the lower and outer edge of the base, and into the anterior half of the cornu of the os hyoides. This muscle is concealed by the sterno hyoideus and omo hyoideus muscles, and lies upon the thyroid cartilage and thyro hyoid ligament.

Use.—To draw the os hyoides downwards, and thus assist the sterno hyoid, thyroid and omo hyoid muscles in fixing it.

The *m. omo hyoideus*—a thin lengthened muscle, taking an oblique direction on the side of the neck; it *arises* from the superior costa of the scapula, near the proper notch of that bone, and from the ligament which passes across the notch to form it into a foramen; it then passes upward posterior to the clavicle, and crosses that triangúlar space which has been described as being formed by the clavicle inferiorly, and by the sterno mastoid and trapezius muscles laterally; at the posterior edge of the sterno mastoideus it becomes tendinous, and passes behind this muscle in a direction forming an acute angle with the clavicle; it again becomes fleshy as it approaches the outer edge of the sterno hyoideus: and now altering its direction, passes nearly vertically upwards to be *inserted* into the os hyoides, at the junction of its body with its cornea. This muscle at its origin is deeply seated behind the clavicle, and is covered by the platysma myoides and the trapezius, then by the sterno cleido mastoideus: it crosses the scaleni muscles, the cervical nerves, the carotid sheath, the thyroid gland, and at its insertion is situated to the outer side of the sterno hyoid muscle: it receives a complete covering from the deep cervical fascia.

Use.—To lower the os hyoides, and direct it outwards and backwards, and also to assist in attaching the scapula to the trunk.

The last and fifth muscle which serves to fix the os hyoides, is

The *m. stylo hyoideus*—which *arises* by a short tendon from the base of the styloid process of the temporal bone, connected to it by a small bursa; it then passes downwards and forwards, in its course bifurcating so as to admit the tendon of the digastric muscle to pass through it; its fibres again unite to be *inserted* into the anterior part of the body of the os hyoides. This muscle is at first covered by the posterior belly of the digastricus; it crosses the carotid artery, jugular vein and lingual nerve; having on its inner side the stylo glossus and stylo pharyngeus muscles, and at its insertion lying upon the hyo glossus.

Use.—To draw the os hyoides upwards and backwards, to act as an antagonist to the muscles just described, and to assist in fixing the bone.

We may next proceed to those muscles which depress the lower jaw, and which are situated between the inferior maxillary bone and the os hyoides. This course of description is in exact consonance with the anatomical and physiological consideration of function.

The muscles situated between the lower jaw and os hyoides are four on either side of the median line, and are for the purpose of depressing the inferior maxillary bone when the os hyoides is fixed, or to raise that bone in the process of deglutition when the mouth is closed.

The *m. digastricus,* or *biventer maxillæ.*—This is the first muscle which presents itself to view. As its name implies, it is composed of two fleshy portions: the *posterior* belly *arises*, broad and thick, from a depression on the inner side of the mastoid process of the temporal bone; it passes downwards and inwards towards the os hyoides, becoming thinner as it descends; and as it approaches that bone, it forms a small rounded tendon, which passes through the fibres of the stylo hyoideus muscle, and then becomes fixed to the os hyoides by a process of aponeurosis, which is given off from the tendon. From this point the *anterior* belly may be said to commence, which ascends, passing at the same time forwards and inwards, and becoming broader as it approaches the lower jaw, passes to be *inserted* by aponeurotic fibres into a fossa situated by the side of the symphysis.

The posterior portion of this muscle is partly covered by the three muscles which are inserted into the mastoid process of the temporal bone: namely, the sterno cleido mastoideus, trachelo mastoideus, and splenius; and the remaining part by the platysma myoides. It covers the three muscles arising from the styloid process of the temporal bone, crosses the carotid vessels, internal jugular vein, lingual nerve, hyo glossus, and mylo hyoideus muscles; and in the triangle formed by the two bellies of this muscle and the base of the lower jaw, the submaxillary gland is placed.

Use.—When both the bellies of this muscle act, the os hyoides being fixed, the lower jaw is depressed, and the mouth opened; if the anterior belly alone acts, it is for the purpose either of raising the os hyoides, and carrying it forwards, or for depressing the lower jaw, according with the bone that offers the fixed point for the action of the muscle; if the posterior belly alone acts, it either draws the os hyoides backwards, or, if that bone be fixed, it assists in raising the upper jaw, by drawing the head backwards.

The *m. mylo hyoideus.*—This muscle *arises*, by short tendinous fibres, from a line placed on the inner side of the lower jaw, extending from the last molar tooth to the centre of the inner surface of the symphysis, where the muscle meets with its fellow on the opposite side, and they unite sometimes fleshy, and at others by a small tendinous rapha; it then passes downwards and backwards to be *inserted* tendinous into the fore part of the os hyoides; its anterior fibres being shorter than the posterior, which pass from one bone to the other in nearly a vertical direction.

The cutaneous, or under surface of the mylo hyoideus, has in contact with it the platysma myoides, the anterior belly of the digastricus, and the submaxillary gland. The upper, or lingual surface, covers the genio hyoideus, genio hyo glossus, and hyo glossus muscle; the sublingual gland, duct of the submaxillary gland, lingual, and lingual gustatory nerves.

Use.—One of these muscles seems scarcely capable of action without its fellow; they are together for the purpose of depressing the lower jaw, or of raising and drawing forwards the os hyoides, and parts attached to it, pushing the tongue upwards towards the palate.

The *m. genio hyoideus—arises* by strong and short tendinous fibres, from a small tubercle situated in the inner surface of the symphysis of the lower jaw; gradually becoming thicker and broader, it passes downwards and backwards, to be *inserted* into the anterior surface of the body of the os hyoides. Its cutaneous, or under surface, is covered by the mylo hyoideus muscle; its posterior, or upper surface, is in contact with the genio hyo glossus, and its inner surface with its fellow.

Use.—The genio hyoideus muscle assists either in depressing the lower jaw, when it acts with the sterno hyoideus, of which it seems as a continuation; or in elevating the os hyoides.

The *m. genio hyo glossus.*—This muscle may be divided into two portions; its genio hyoideal, and its genio glossal fibres; the former is that portion which is now to be described as assisting in the function of those muscles which depress the lower jaw, or raise the os hyoides; it takes precisely the same course from the symphysis of the jaw to the os hyoides, as the last described muscle, its under surface being in contact with that muscle; its inner surface, with its fellow, and its upper, being contiguous with its genio glossal fibres; which portion of this muscle will be described with the muscles proper to the tongue.

The *use* of this part of the muscle is the same precisely as the genio hyoideus. The lower jaw, by this last set of muscles, being depressed, it may be well to consider the mouth opened, for the purpose of taking in food, that we may be enabled physiologically to describe the muscles as they present themselves to view in this dissection, according to the function they are destined to perform in the process of mastication and deglutition: and first of these the four muscles of mastication, or those which raise the lower jaw, and close the mouth.

Before describing the origin and insertion of the temporal muscle, its aponeurotic covering must be spoken of. This aponeurosis arises upon the lateral surfaee of the skull, from a white arehed line, which extends on the frontal parietal and temporal bones; or may be eonsidered as a continuation of the epicranial fascia: it proceeds downwards to the zygomatie arch, and is attaehed to the whole length of its upper border, in its course splitting into two portions, the inner of which passes between the fibres of the temporal musele, so as to divide them into a superfieial and deep set, the superfieial being the most attenuated.

The *m. temporalis—arises* from the inner surface of the temporal faseia, and from the whole length of the white arehed line which extends over the frontal, parietal and temporal bones, forming the boundary of the temporal fossa; from these points of origin the fibres pass downwards, converging as from the circumference to the centre of a eirele, and opposite the zygomatic areh, terminating in a very strong tendon, whieh deseends vertieally to the coronoid proeess of the lower jaw, into the whole of which it is *inserted.* The external surface of this musele is fleshy, the internal tendinous, and partieularly at the lower part, just as it is passing to be inserted. The temporal muscle is eovered externally by its aponeurosis, by the anterior and levator muscles of the car, whieh arise from the temporal fascia, and also by the zygomatic arch; its internal surface covers first the temporal fossa formed by the bones of the head, the pterygoideus externus muscle being only separated from it by fat, and the internal maxillary artery. The anterior fibres of this musele, which pass from the frontal temporal fossa, are on a plane, deeper seated than the posterior, or zygomatic fibres, as they are directed to the coronoid process.

Use.—To draw the lower jaw upwards and backwards, and to press the teeth of the two jaws together. If the posterior fibres of this muscle alone act, they have, in a slight degree, the power to depress the lower jaw, and open the mouth; which being completed, places the anterior fibres in the best possible position to close the mouth again, both by depressing the head, and elevating the jaw.

The *m. masseter—arises* from the two anterior thirds of the inferior edge of the zygoma. The posterior fibres of this muscle are aponeurotic, pass in a direction from above downwards, and from behind forwards, forming a strong external tendinous surface to this portion. The anterior fibres are fleshy, passing from before backwards towards the lower jaw, are the most internally situated, so that the fibres of these two origins decussate and pass to be *inserted* into the base of the lower jaw, in a space between its angle and the origin of the depressor anguli oris. The external surface of the masseter is covered partly by the parotid gland, and is traversed by its excretory duct; it is also covered by the platysma myoides, branches of the fascial nerve, and temporal artery: its internal surface covers the ramus of the lower jaw, the insertion of the temporal muscle and the buccinator, from which it is separated by a large quantity of fat.

Use.—When both of its layers act, to raise the lower jaw, which it effects to a great advantage, from the obliquity and decussation of its fibres; but when they act separately, the jaw is drawn alternately backwards and forwards, so as to grind the teeth together: it is, therefore, one of the most important muscles in mastication.

The best mode of exposing the pterygoid muscles, is to saw through the neck of the lower jaw, and through the base, just at the anterior edge of the masseter muscle, and thus to remove the whole of the ascending ramus.

The *m. pterygoideus internus—arises,* strong and tendinous, from the fossa between the external and internal roots of the pterygoid process of the sphenoid bone, and from the pterygoid process of the os palati; it then becomes fleshy, and passes obliquely downwards from behind to before, to be *inserted* into the inner side of the angle of the inferior maxillary bone, in a similar manner to the insertion of the masseter on the outer side of the angle of the same bone; the tendons of the two uniting underneath, form a kind of sling for the reeeption of the lower jaw. This musele is covered by the aseending ramus of the lower jaw; it is separated from the pterygoideus externus, by the internal maxillary artery, the lingual gustatory nerve, and eellular membrane; and along its posterior edge, the internal lateral ligament passes from the styloid proeess to the angle of the jaw.

Use.—When one of these muscles acts, it draws the lower jaw obliquely to the opposite side; when both act, they raise the lower jaw, and close the mouth; and if they act when the superior and inferior maxillary bones are in contact, they incline the head slightly backwards.

The *m. pterygoideus externus—arises* from the external root of the pterygoid proeess of the sphenoid bone, from the root of the temporal proeess of the same bone, and also from the tuberosity of the os maxillare superius, adjoining the pterygoid proeess of the sphenoid; at this point being eonneeted with the bueeinator, and superior eonstrietor of the pharynx: from these several origins its fibres pass baekwards and outwards almost transversely, to be inserted into a fossa in the eondyloid process of the lower jaw, and into the ligament whieh surrounds the artieulation of this bone with the temporal. This musele, like the pterygoideus internus, is eovered by the ramus of the lower jaw and museles of the faee.

Use.—When this muscle acts singly, the jaw is directed forwards, and to the opposite side; when both muscles act, the jaw is moved horizontally forwards.

These four museles are most espeeially employed in the proeess of mastieation; the aetion of the temporal and masseter preponderates in the preparation of animal food for deglutition; whilst the pterygoid museles, from the peculiar motions they give to the lower jaw, are best adapted to break down and triturate vegetable matter; so that the comparative development of these muscles forms a distinguishing mark between carnivorous and graminivorous feeders. In man, who is termed omnivorous, these four pairs of muscles being equally developed, all kinds of food are thoroughly prepared by them for deglutition. We may now take into consideration those muscles which are destined to collect and form the masticated food into a bolus, for the purpose of its being passed into the fauces; this office is performed by the

Muscles of the Tongue.

The tongue is composed of muscle, and is covered by mucous membrane; it is attached behind to the os hyoides by a broad base, while anteriorly it is narrow and pointed, and capable of being turned and twisted in every direction, to enable it to collect the food, and perfectly mix it with the secretions of the mouth. The tongue, although it has all the appearance of a single organ, yet might with propriety be considered a double one, being furnished with a central rapha, and perfectly symmetrical organized sides, which are, in a great measure, independent of each other. This may be frequently seen in hemiplegia, where one side has completely lost its power of function, while the other remains perfect. The principal bulk of the tongue is made up of four pairs of muscle, which are placed in the following order, and are to be dissected by dividing the jaw at the symphysis, and by drawing the tongue forcibly forwards out of the mouth; thus bringing into view, first,

The *m. genio hyo glossus.*—The anterior fibres, or genio hyoideal portion of this muscle have already been described as acting solely with those placed between the os hyoides and lower jaw; but the genio glossal portion, or posterior fibres, are now to be considered, as belonging especially to the tongue. They *arise* from a protuberance on the inner surface of the symphysis of the lower jaw, above the origin of the genio hyoideus; from this, as from a centre, the fibres radiate, passing forwards to the tip, upwards to the centre, and backwards to the base of the tongue, forming thus the inner boundary of each half. The posterior fibres send off a delicate tendinous fasciculus to the os hyoides, which passes to be indirectly connected with the base of the epiglottis.

This muscle is bounded inferiorly by the genio hyoideus, superiorly by the mucous membrane of the mouth, externally by the sublingual gland, the lingualis, and hyo glossus muscles; internally it is firmly connected with its fellow by strong condensed cellular tissue forming the rapha.

Use.—All the fibres of this muscle assist in pushing the tongue out of the mouth, the anterior fibres draw it back again, while the middle fibres render the dorsum of the tongue concave, the fasciculus, which passes to be attached to the base of the epiglottis, pulls that fibro cartilage forwards and upwards.

The *m. lingualis,*—as its name would imply, is only attached to the tongue; *arising* from the base of that organ, it proceeds forwards to the tip, in which it may be said to be *inserted.* It has to its inner side, along its whole length, the genio hyo glossus. On its outer side, for the posterior two thirds, the hyo glossus; and on the anterior third, the stylo glossus muscle: above and below it is in contact with the mucous membrane of the mouth, and its fibres are intimately connected with the muscles which bound them laterally.

Use.—To shorten the tongue, and direct the tip towards the frænum linguæ, and floor of the mouth.

The *m. hyo glossus—arises* from the os hyoides by three separate fasciculi, in such a manner as to have been described by Albinus as three distinct muscles, bearing each a distinct name, according to their attachments; it may, however, with propriety be described as one muscle, *arising* from the outer half of the base, and part of the cornu of the os hyoides, passing upwards to be *inserted* into the posterior two thirds of the tongue.

The under surface of this muscle, at its hyoideal attachment, is covered by the mylo hyoideus, stylo hyoideus, and digastricus muscles; as it proceeds towards the tongue, by the lingual and lingual gustatory nerves, submaxillary gland, and excretory duct; at its insertion it is placed between the stylo glossus on the outer side, and the lingualis on the inner; above it is covered by the mucous membrane of the mouth; and some few of its fibres are connected with the middle constrictor of the pharynx, at its hyoideal attachment.

Use.—When one muscle acts, it depresses the base of the tongue, obliquely drawing it to one side: when both act, it either depresses the whole base, or raises the os hyoides if the tongue be fixed.

The *m. stylo glossus*—*arises,* thin and tendinous, from the apex of the styloid process of the temporal bone, below and in front of the stylo hyoideus muscle, and also from the stylo maxillary ligament; it then descends, becoming broader and thinner, to be *inserted* into the whole length of the outer edge of the tongue.

This muscle is bounded externally by the digastric muscle, lingual nerve, and mucous membrane of the tongue; internally, by the superior constrictor of the pharynx; by the hyo glossus muscle posteriorily, and the lingualis anteriorly.

Use.—To carry the tongue upwards, backwards, and obliquely to one side, when acting singly: but when both act, they direct the tip of the tongue to the roof of the mouth, and contract both its longitudinal and lateral dimensions.

The next part called into action in the function of deglutition; under which consideration I have classed the muscles of the tongue; is the fauces, which is a narrowed arched canal, connecting the posterior part of the mouth with the pharynx. It is bounded below, by the base of the tongue; above, by a soft muscular moveable curtain, which is termed the velum pendulum palati; and on either side by two pillars; the anterior of which is termed the constrictor isthmi faucium; the posterior, the palato pharyngeus; which, in their descent, diverge, so as to admit the tonsil gland between them. From the centre of the velum pendulum palati, a soft triangular portion falls down in the middle line, so as in some measure to divide the opening of the fauces into two passages: this process, which is muscular, is termed the uvula. All these parts are covered by a continuation of the mucous membrane of the mouth, which must be removed, to expose the muscles of the fauces of the soft palate, and the muscles which move the soft palate.

It will facilitate the dissection of the muscles of these parts, to bear in mind, that the constrictor isthmi faucium, palato pharyngeus, and azygos uvulæ, are common to the fauces and velum pendulum palati, and that the circumflexus and levator palati are proper to the soft palate.

The *m. constrictor isthmi faucium*, or *glosso staphylinus*—*arises*, by thin and slender fibres, from the sides of the root of the tongue; it ascends in the form of an arch in front of the tonsil; and in the middle line, at the posterior edge of the palatine processes of the palate bones it *joins* with its fellow, and with the palato pharyngeus muscle, to form the velum pendulum palati, sending fibres down into the uvula. This muscle below is bounded by the tongue, above by the soft palate, on its outer side by the insertions of the circumflexus and levator palati, and on its inner by its fellow: both its surfaces are covered by mucous membrane, and it has the tonsil situated immediately behind it.

Use.—To draw the soft palate towards the tongue, and consequently contracts the opening of the fauces; and when the soft palate is fixed by the tensores palati, then the constrictor isthmi faucium raises the tongue.

The *m. palato pharyngeus*, or *pharyngo staphylinus*—*arises* from the lateral parietes of the pharynx, in common with the superior and middle constrictors, where they are connected with the thyroid cartilage; from this origin the fibres pass upward behind the tonsil, forming the posterior pillar of the fauces; it then directs itself inwards towards the posterior edge of the palatine vault; dividing however into two layers, and admitting the tendon of the tensor palati between them, the muscle then joins its fellow of the opposite side, the constrictor isthmi faucium, and uvula, completing the velum palati. The situation of the muscle is sufficiently described in speaking of its attachments.

Use.—To lower the velum pendulum palati, or to raise and shorten the pharynx: it acts principally in deglutition.

The *m. azygos uvulæ,* or *levator uvulæ,* or *palato staphalinus*—is a small elongated muscle, which *arises* from the extremity of the nasal spine of the palate bones, and from the tendons of the tensores palati; its fibres being also connected with the palato pharyngeus, passes down the whole length of the uvula, to be *inserted* into its tip.

This muscle is not always single, but sometimes forms two distinct lateral fasiculi.

Use.—To raise the uvula, make it shorter, and curve it forward.

The muscles which act upon this muscular curtain, so as to render it capable of preventing the food passing in any other direction than into the pharynx, are the tensor and levator palati.

The m. circumflexus palati, tensor palati, or *pterygo staphylinus—arises,* principally tendinous, from the extremity of the spinous process of the sphenoid bone, posterior to the foramen spinosum, and also from the fibro cartilaginous tissue of the eustachian tube; it then takes its course downwards, forwards and slightly inwards, along the posterior edge of the pterygoideus internus muscle, as far as the extremity of the internal pterygoid lamella of the sphenoid bone, and there it becomes tendinous, alters its course, winding around the hamillary process of that bone, and being furnished there with a bursa mucosa, it is then reflected upwards and inwards, and spreads itself into a broad tendinous expansion, to be *inserted* into the velum pendulum palati; its fibres emerging with those of the palato pharyngeus and superior constrictor of the pharynx.

This muscle is situated in front, and below the eustachian tube, immediately behind the foramen spinosum, and consequently the spheno spinal artery, which passes through that foramen to the dura mater.

Use.—To draw the soft palate very slightly downwards, but principally to stretch it, by drawing it outwards.

The *m. levator palati mollis,* or *petro staphylinus—arises* from the anterior extremity of the petrous portion of the temporal bone, and from the eustachian tube; from these points it is directed downwards and inwards, passing between the occipital and sphenoidal origins of the superior constrictor of the pharynx, it is *inserted* into the whole length of the velum, as far as the azygos uvulæ. The two muscles in the median line are so intimately connected with each other, as to form an arch, the convexity of which is directed downwards, and rests upon the palato pharyngeus muscles.

This muscle is situated behind and above the eustachian tube, which is found between this and the last described muscle.

Use.—To raise the soft palate, bringing it on a plane with the roof of the mouth; so as to cut off the communication between the upper part of the pharynx, into which the nares and eustachian tubes open; from the lower part, which leads into the œsophagus.

The narrow opening leading from the mouth to the pharynx, is termed the isthmus faucium, which may be either enlarged or contracted by the action of the five pairs of muscles which have been just described. It is by the different motions of the soft palate, which forms the upper boundary of this passage, that the food is directed into the pharynx; that inspired air is led into the glottis; or that expired air is forced partly through the nostrils, or into the cavity of the tympanum: hence at once it is clear, from this consideration, that this part has most important and very different functions to perform, and requires therefore a complicated and perfect organization to render it efficient to its several offices. In looking into the posterior part of the mouth, the uvula is seen hanging down from the centre of the velum pendulum palati; to this little body may be adjudged the peculiar power of preparing the whole apparatus for the next office to be performed, it may indeed be considered as the centinel which regulates the direction of the substances which are intended to be swallowed or ejected, and of the air which is either to be inspired or expired; and at the same time keeping the parts in such reciprocal action, that the function of respiration should not be suspended during the process of deglutition. To effect this multiplied action, we find the uvula connected with, or may indeed be said to be made up of all the muscles of the velum. Hence it is, as we frequently find in disease, that any loss of substance to this part interferes with these functions; that the food passes into the nostrils, and that the voice also becomes altered and unnatural.

Both for the purposes of deglutition and respiration, it is necessary for this narrow passage to be constantly lubricated by mucous: we find, therefore, a large gland on either side the isthmus, placed under the influence of the two muscles which form the pillars of the fauces, and which compress the secretion from this gland at the very time it is most required, while the food is passing; and it is further supposed by some physiologists, that the uvula assists in lubricating the pharynx, not only by its enlarged surface of mucous membrane, but also by directing the secretion of the tonsil gland into the middle line of the fauces and pharynx. The food having now been masticated, mixed with the saliva, and formed into a bolus by the motions of the tongue, is forced through the isthmus faucium by the constrictors of the fauces into a membranous muscular sac, which is termed the pharynx. The term sac, however, is not quite appropriate to its form, as will be found from a careful examination of the part. The posterior wall of the pharynx is made up of three flat muscles, which are contiguous, but nevertheless lie on different planes with respect to each other; the one is superior, and at the same time anterior; the second intermediate, whilst the inferior is upon a plane posterior to both. This muscular wall, first considering it as one muscle, *reaches* from the cuneiform process of the occipital bone, to the cricoid cartilage of the larynx, being of a funnel-shaped form, larger above than it is below; it is bounded *posteriorly* by the longus colli muscle, and the three superior cervical vertebræ; *anteriorly* it is formed by other organs into a canal, which has led me to say it is not appropriately called a sac; it opens above into the nose; into the eustachian tubes; then into the mouth, through the medium of the fauces; lower down into the larynx, through the glottis; and, lastly, to its termination, where it is successively bounded by the os hyoides, thyroid, and cricoid cartilages of the larynx: but each of the openings, as has been before mentioned, are capable of being closed or opened by the action of the muscles of the fauces. *Laterally* the pharynx is bounded by the petrous portions of the temporal bones, the pterygoid processes of the sphenoid, the two jaws behind their molar teeth, the tongue, the cornua of the os hyoides, and lastly, the lateral parts of the thyroid and cricoid cartilages. Besides this muscular posterior parietes to the pharynx, there are two small muscles laterally placed, which pass from the styloid processes of the temporal bones, and which serve to keep the pharynx, during deglutition, in the best position to receive the food from the fauces.

Having taken this general view of the pharynx, the muscles should now be dissected, by cutting through the trachæa, and turning the larynx and pharynx upwards; or they may be still better displayed, by removing the head from the body: in either case, they must be dissected from behind, and consequently it is the lower portion of the muscle, which has already been described as most posterior, which first comes into view; this is termed

The *m. constrictor pharyngis inferior.*—This is the longest of the muscles of the pharynx; it is broad, and irregularly quadrilateral; *arises* from the sides of the cricoid cartilage, near the crico thyroideus muscle, from the alæ of the thyroid cartilage, immediately behind the thyro hyoideus muscle: from these origins its fibres pass upwards and backwards to be *inserted* into the mesian line, by uniting with its fellow, and forming a rapha; its superior fibres are long, and pass nearly vertically, so as to form a very acute angle with those of the opposite side; the inferior are short, and run transversely along the posterior part of the lower edge of the cricoid cartilage, to be connected with the upper part of the œsophagus.

This muscle rests upon the rectus capitis anticus major and longus colli muscles, and its anterior surface is covered by the middle constrictor of the pharynx.

The *m. constrictor pharyngis medius.*—This muscle *arises* from the superior part of the cornua of the os hyoides, reaching as far anteriorly as the appendix; it also arises from the thyro hyoid ligament, its superior fibres pass upwards with great obliquity to be *inserted* into the cuneiform process of the occipital bone, while the rest of its fibres pass more inwards, to meet corresponding fibres of the muscle on the opposite side, and form a rapha, covering the posterior surface of the superior constrictor. The lower part of this muscle posteriorly is covered by the last described muscle, while above it covers the inferior fibres of the constrictor pharyngis superior.

The *m. constrictor pharyngis superior.*—This muscle *arises* above from the cuneiform process of the occipital bone, anterior to the insertion of the middle constrictor, in front of the foramen magnum; it also arises from the pterygoid process of the sphenoid bone, from the superior and inferior maxillary bones behind the dentes sapientiæ, being here connected with the buccinator muscle, and from the sides of the base of the tongue, between the stylo and hyo glossus muscles. The fibres proceed in a transverse direction, to be *inserted* by interlacing with those of the opposite side, and form a rapha in the middle of its posterior surface.

The largest part of this muscle posteriorly is covered by the middle constrictor; anteriorly it is covered by the mucous membrane of the alimentary canal, and is bounded by the openings of the nares, eustachian tubes, and glottis.

Use of these muscles. The whole of the fibres serve to contract the pharynx, but that part of the muscle only contracts which is stimulated by the presence of the food: the middle constrictor also raises the os hyoides, and the larynx thereby shortening the canal, and at the same time drawing the tongue upwards and backwards, assists in closing the glottis; the inferior constrictor raises the larynx, and draws the œsophagus upwards.

The *m. stylo pharyngeus.*—This muscle *arises*, by a thin tendon, from the inner side of the base of the styloid process of the temporal bone; it passes downwards and backwards to be *inserted* into the side of the pharynx, sending some fibres to the os hyoides and thyroid cartilage, and mingling with those of the palato pharyngeus muscle.

This muscle is deeply seated, its origin being covered by the stylo hyoideus and stylo glossus muscles, and its insertion, by the middle constrictor of the pharynx.

Use.—To raise the pharynx, and at the same time to widen it, and render it better capable of receiving the food. This muscle in its dissection may be classified as one of the three muscles arising from the styloid process, and being situated transversely between the os hyoides and lower jaw; but then its situation alone would be learnt, and not its function, which should always be the paramount consideration.

From the pharynx the ingesta pass into the œsophagus, an organ which will be described with those of digestion.

Practical Remarks.

The neck has been already described, as that part of the body which is situated between the chest and head. From the numerous and important parts which are connected with it, such are the organs of deglution, respiration, large arteries, veins, and nerves, &c., the wounds of this part require a treatment at once ready and efficient, and such as can only be recommended by a surgeon, who, familiar with the anatomy and physiology of all the structures, is at first view capable of forming a just opinion as to the necessary means to be employed for the relief of the patient.

To simplify these considerations, the neck should be divided into four regions; an anterior, two lateral, and a posterior region.

The anterior region is triangular, and is bounded above by the lower jaw, reaching as far laterally as the mastoid processes of the temporal bones, below by the sternum forming the apex of the triangle, and laterally by the two anterior edges of the sterno cleido mastoidei muscles. This space should be subdivided into thirds, the upper third between the os hyoides and the lower jaw: the middle third between the os hyoides and the cricoid cartilage; and the lower third between the cricoid cartilage and the sternum. In a surgical point of view, wounds of the upper third are the least important; of the middle third, of greater; and of the lower third, of the greatest importance; for the following reasons. Wounds of the upper third would divide chiefly muscular parts, without leading to much apprehension from hæmorrhage, in consequence of the comparative smallness of the vessels of this region; if the incision be carried deeper, the pharynx is laid open, which is indicated by the flow of mucous from the wound, and sometimes also saliva, if the excretory duct of a salivary gland be divided; if the wound of this region be extended outwards, the cutting instrument would pass into the digastric triangle, which is comprehended between the symphysis of the lower jaw, the mastoid process of the temporal bone, and the junction of the digastric tendon with the os hyoides; in which space the facial vein, submaxillary gland, facial artery, and lingual nerve, are in danger of being wounded. These occurrences would be rendered obvious by a flow of venous blood, of saliva, of arterial blood, and a paralysis of the tongue. In either case, or in a complication of them, the object of the surgeon would be to stop severe hæmorrhage, to bring the divided parts into close adaptation with sutures, and by the position of the head, to secure the parts from the disturbances of motion. This is effected by bringing the head forwards, drawing the chin towards the sternum, and carefully securing it with bandages in that position. A wound into the upper part of the middle third of the neck, may divide, besides the muscles, the superior thyroideal artery, which would be indicated by hæmorrhage; it may open the pharynx, by cutting through the thyro hyoideal ligament, which would be evinced by the escape of the contents of that organ; below this, it may open the larynx by the division of the thyroid cartilage, shown by the escape of air; still, however, with the retention of voice: if at the lower part of the middle third the larynx be opened by an incision between the thyroid and cricoid cartilages, at the same time wounding the thyroid gland, this accident would be obvious, from the frequent and forcible expulsion of air, blood, and frothy mucous though the wound, but unattended with voice, in consequence of the opening being below the vocal chords. The wound may also extend so far backwards as to open the pharynx, which would be shewn by the escape of saliva and mucous. The treatment in these accidents is the same as in wounds of the upper region.

Wounds of the inferior third would divide the trachæa, the œsophagus, and as happen, in most instances, the jugular vein and carotid artery, from their greater proximity to the anterior surface of this division of the neck: if the incision be made very deeply, the par vagum may also be divided. These parts may indeed be wounded by a deep incision in the middle division; but from their greater depth, and the protection afforded them by the firm cartilages of the larynx, they are in that situation less liable to injury. In division of the trachæa and œsophagus only, the divided parts are to be brought into close adaptation, and treated as before. When the large blood-vessels are divided, the sudden and great loss of blood has generally destroyed life before surgical aid could be attained ; but should not life be extinct, may not such accidents offer fair opportunity for the trial of transfusion of blood, as the best chance of restoring the patient.

It may be well here to remark, that in operations of the anterior region of the neck, the anterior edges of the sterno cleido mastoidei form a general direction to the course of the common and external carotid arteries. Again, with regard to operations of this region, there is no part of the body in which position is of greater importance, as the elevation or depression of the head and lower jaw alter materially the relative position of the larynx and os hyoides. This may be exemplified by the measurement of the elevation and depression of the thyroid cartilage and os hyoides in various subjects, and should be observed with regard to each individual subjected to operation.

The lateral regions of the neck are comprehended in an irregular triangle, the base of which is formed by the middle third of the clavicle, the apex immediately below the mastoid process of the temporal bone, anteriorily bounded by the posterior edge of the sterno cleido mastoideus, and posteriorly by the anterior edge of the trapezius. The whole of this space is covered by the platysma myoides muscle, which is necessary to mention, from its relation to the operation of bleeding in the external jugular vein. The external jugular vein lies immediately under the platysma myoides upon the sterno cleido mastoideus; the opening of this vein differs from bleeding elsewhere, as we necessarily puncture it through muscular fibre, the contraction of which the surgeon has to contend against. Having described the platysma myoides, and its relation to the external jugular vein, we will now proceed to the subdivision of this lateral region into two spaces, each of them of a triangular form. The lowest of these two spaces is bounded in front by the posterior edge of the sterno cleido mastoideus and external jugular vein ; below, by the clavicle ; above, by the omo hyoideus, and behind, the triangle terminates, where the omo hyoideus crosses behind the trapezius muscle. This space is rendered of great consequence, from the numerous parts and important surgical operations connected with it. It is within this triangle that a ligature may be placed around the subclavian artery for axillary aneurism, an operation rendered difficult from the smallness and depth of the space, which includes on the inner side of the artery the scalenus anticus muscle ; on the outer side, the nerves joining to form the axillary plexus : and in front the subclavian vein traversing the lower portion of the artery immediately above the clavicle. The experienced anatomist readily avoids these difficulties, by making the outer edge of the scalenus muscle his guide to the artery, which lies immediately beneath it, on the first rib, and cannot with safety be tied until the edge of this muscle is *distinctly* exposed.

In that portion comprehended above the omo hyoideus muscle, the parts are of much less surgical importance; in it may principally be remarked the numerous superficial branches of the cervical nerves. The posterior cervical region is comprehended between the protuberance of the occiput above, the outer edges of the trapezii laterally, and a line drawn from the acromion of the scapula of one side to the other. This space is not rendered of much surgical importance, excepting from the aponeurotic covering which lies immediately underneath the common integument. This part, possessing such little vitality, has a tendency to run into suppuration, and is the reason of the danger attending carbuncle in this situation.

LECTURE XV.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Upper Extremity.

It is here necessary to give the reason why the muscles of the upper extremity should follow before I have finished the description of the muscles of the neck. Had we proceeded, in continuation of the descriptive anatomy of the muscles deeply seated in the neck, we must of necessity have removed those muscles of the upper extremity, as they cover the deep-seated muscles of the posterior cervical region; and the student could not have continued this progress of dissection without the destruction of that part of the body. Also, the muscles of the neck not yet described, may with greater propriety be considered separately, as they are not connected with the functions of deglutition and mastication, as those already described.

The muscles of the upper extremity are divided into those which attach the scapula to the trunk; those which move the shoulder-joint; those of the elbow-joint; the muscles of the radio ulnar articulations; muscles of the wrist joint; those common to the fingers; those proper to the fingers; and, lastly, the muscle of the palmar fascia. The muscles which attach the scapula to the trunk are seven in number, although, if we consider the subclavius muscle as assisting in this attachment, it will make the number eight. They are situated, in relation to the scapula, in the following order:—two above, three behind, and three in front; enumerating the subclavius, which is, however, frequently considered as a muscle proper to the clavicle.

The three muscles situated behind the scapula should be the first dissected, as the muscles above the scapula cannot be exposed until they are removed.

The *m. trapezius.*—This muscle *arises* aponeurotic from the middle of the superior transverse arch and protuberance of the os occipitis, from the ligamentum nuchæ, and from the spinous process of the seventh cervical, and all the dorsal vertebræ; from these different origins the superior fibres pass downwards and outwards, to be *inserted* into the outer third of the clavicle; the middle fibres pass transversely outwards, to be *inserted* into the spine of the scapula; and the inferior fibres pass upwards, reaching as far as the acromion process, into which they are *inserted.*

This is the most superficial muscle of the posterior part of the trunk, and is consequently covered by skin, being firmly connected to it by a dense fascia: it covers on the back the complexus, splenius, levator scapulæ, rhomboidei, and part of the latissimus dorsi muscles; on the scapula it covers the supra and infra spinati, and along the spine has its tendinous insertion connected with the origin of the deltoid. In the whole length of its origin it is connected with its fellow; the clavicular insertion of this muscle is also connected with the deltoid muscle, as on the spine of the scapula.

Use.—When the whole of the muscle acts, it draws the clavicle and scapula backwards, the superior fibres raise the clavicle and scapula upwards as well as backwards, the middle fibres approximate the scapulæ, and the inferior fibres draw the scapulæ downwards. The scapulæ being fixed, the trapezii extend the head; or, if only one muscle acts, it draws it to one side.

The *m. rhomboideus major.*—This muscle *arises,* by aponeurosis, from the lateral part of the extremities of the spinous processes of the five superior dorsal vertebræ; and from the interspinal ligaments, it soon becomes broad and fleshy, and passes in a direction downwards and outwards, to be *inserted* into that portion of the posterior costa of the scapula below the spine, sometimes reaching to the inferior angle. The rhomboideus major muscle is covered partly by the trapezius and partly by the latissimus dorsi; a small portion being seen between these muscles, and the inferior part of the base of the scapula.

Use.—To draw the scapula backwards, and at the same time the inferior angle upwards, which directs the anterior angle and glenoid cavity forward.

The *m. rhomboideus minor.*—This muscle *arises* from the sides of the apices of the sixth and seventh cervical vertebræ, and from the termination of the ligamentum nuchæ; its fibres then pass downwards to be *inserted* into the posterior costa of the scapula, above the spine. This muscle is inserted immediately below the levator scapulæ; in other respects it is situated the same as the rhomboideus major, the two being sometimes described as one muscle.

Use.—To draw the scapula obliquely upwards and inwards.

The two muscles which fix the scapula above, are the omo hyoideus and the levator scapulæ; the origin and insertion of the former has already been described, having been classified with those muscles which serve to fix the os hyoides; but as it does also assist in raising the scapula, it is necessary now to name it, without however recapitulating its origin and insertion.

The *m. levator scapulæ.*—This muscle *arises* by five distinct tendinous origins from the transverse processes of the five superior cervical vertebræ, but more frequently only from the three superior; these tendinous origins pass downwards, and soon become distinct fleshy bundles, which unite below, forming one muscle, to be *inserted* fleshy into the posterior part of the superior angle of the scapula. The five origins of this muscle are anteriorly covered by the sterno cleido mastoideus, more deeply by the scalenus medius muscle, posteriorly by the trapezius and splenius capitis, and still deeper by the splenius colli: the insertion of the levator scapulæ has the origin of the omo hyoideus in front of it, the rhomboideus minor behind it, the supra spinatus below it, and is covered by the trapezius.

Use.—To draw the scapula upwards and slightly forwards, or, if the scapula be fixed, it inclines the neck to its side.

The three muscles attaching the scapula to the anterior part of the trunk, are the pectoralis minor, serratus magnus, and subclavius.

The *m. pectoralis minor.*—This muscle *arises,* tendinous and fleshy, from the external surface of the third, fourth, and fifth ribs; the fibres then converge, pass upwards and outwards, to be *inserted* into the inner side of the apex of the coracoid process of the scapula.

This muscle is covered by the pectoralis major, while on the chest; but in passing from the thorax to the coracoid process it is covered by the deltoid muscle, and at its insertion into this process it has the subclavius to its inner side, and the coraco brachialis muscle on its outer.

Use.—To draw the coracoid process and scapula downwards and forwards upon the chest; but when the scapula is fixed, it then becomes a muscle of inspiration, by raising the ribs, and acting as an antagonist to the sterno costalis muscle.

The *m. subclavius.*—This muscle *arises* tendinous from the cartilage of the first rib, where it is connected with the sternum; from this origin it passes outwards and slightly upwards, along the inferior surface of the clavicle, as far as the coracoid process, into which it is *inserted,* as well as into the conoid ligament, which connects the clavicle with that process. This muscle is surrounded by the fascia cervicalis profunda, and is situated between the sternum and scapula; it is bounded above by the omo hyoideus, below by the pectoralis minor, a considerable space being between the two, in which the subclavian artery and vein may be seen. Anteriorily it is covered by the pectoralis major, and posterior to it, are placed the subclavian artery, vein, and axillary plexus.

Use.—To draw the scapula and clavicle downwards upon the chest; or if the shoulder be fixed, it raises the first rib and sternum, assisting in inspiration.

The *m. serratus magnus.*—This muscle *arises* by nine distinct digitations, from the nine superior ribs: they form the muscle into distinct fasciculi, which pass backwards to be *inserted* into the internal margin of the base, or posterior costa of the scapula, from the superior to the inferior angle, to both of which it is attached. The serratus muscle is situated between the ribs and the scapula. It covers the eight superior ribs, and their intercostal muscles, being itself covered below by the latissimus dorsi, and above by the subscapularis; its fleshy digitations are of unequal length, the superior being shorter and thicker, while the inferior are longer and thinner, and are connected with the m. obliquus abdominis externus.

Having described the seven muscles connecting the scapula to the trunk, there are yet two muscles which must be dissected before we can detach the upper extremity, and which properly follow now in the order of dissection, as they belong to the set of muscles next to be described.

The muscles of the shoulder joint are nine in number; two arising from the trunk, to be inserted into the os humeri, and seven from the scapula, likewise to be inserted into the os humeri.

The *m. pectoralis major*.—It *arises* tendinous from the sternal half of the clavicle, tendinous from the whole anterior surface of the sternum, fleshy from the cartilages of all the true ribs; and, lastly from an aponeurosis common to it and the external abdominal oblique and rectus muscles. From this extended origin, its fleshy fibres converge, passing across the breast to be *inserted* by a broad flat tendon into the os humeri, attached to the outer edge of the groove which lodges the tendon of the long head of the biceps.

The clavicular portion of this muscle is separated from the commencement of the sternal origin by an intermediate space between its fibres, which is filled up by condensed cellular membrane; this is a space of considerable surgical importance, as behind it, is placed the subclavian artery and vein, covered by the coraco costal ligament. The pectoralis major is superficially situated upon the chest, being only covered anteriorly by the skin and platysma myoides and mamma; it covers the inner half of the clavicle, the anterior surface of the sternum, and the cartilages of the true ribs, the internal intercostal muscles, the serratus magnus, pectoralis minor and subclavius muscles ; to gain its point of insertion, it passes in front of the coraco brachialis and biceps, and behind the inner edge of the deltoid. It forms also the anterior boundary to the axilla.

Use.—To bring the arms forward and across the chest, as in the act of embracing. When the upper extremities are raised above the head and fixed, then this muscle acts powerfully in inspiration; this position is frequently taken advantage of by patients suffering from dyspnœa.

The pectoralis major also assists powerfully in raising the body from the ground when holding by a rope or a beam over the head, and in balancing the body when walking on the hands. This muscle is frequently the subject of varities in the origin and insertion here laid down, the clavicular attachment has in some cases been wanting; the number of the ribs, and the extent of sternum from which it arises, also differ in different subjects; and at the insertion it is not unfrequent to find a portion of the pectoralis major passing to be connected with the brachialis internus.

The *m. latissimus dorsi*—*arises* by a broad tendinous expansion (which forms in fact the posterior layer of the fascia lumborum) from the spinous processes of the sacrum, lumbar and seven or eight inferior dorsal vertebræ, from the posterior fourth of the ilium where it is connected with the origin of the glutæus maximus, from the three or four inferior ribs, near their extremities, by distinct fasciculi which digitate with the obliquus abdominis externus. The iliac and lumbar fibres pass obliquely upwards and outwards; the dorsal pass transversely, and the costal are directed nearly vertically upwards; all converging to the inferior angle of the scapula, over which they pass (frequently gaining a fresh fasciculus from that bone) towards the os humeri, into which this muscle is *inserted* by a flat tendon, along the internal edge of the bicipital groove with the teres major. The tendon by which the latyssimus dorsi terminates its insertion, is about three inches long, and turns one half upon itself, so that its lower edge receives the dorsal fibres, and its upper edge the lumbar and costal fibres of the muscle. This tendon is connected with the tendon of the teres major; and a small bursa is usually found between them.

The upper half of the posterior surface of this muscle is covered by the trapezius, the lower half is immediately sub-cutaneous; the anterior surface is in contact with the serratus posticus inferior, sacro-lumbalis, longissimus dorsi, spinalis dorsi, obliquus abdominis externus, ribs, and inferior angle of the scapula. The tendon of this muscle passes under and behind the coraco brachialis muscle, between it and the bone, to be *inserted* in common with the tendon of the teres major, which reaches, however, rather below it, and is on a plane posterior to it.

Use.—To direct the arm backwards, and slightly rotate the limb inwards; as a muscle of inspiration, it has the power of elevating the ribs when the upper extremities are raised and fixed above the head; in this position they are capable of raising the whole body.

The superior extremity may now be separated from the trunk in the progress of the dissection of the remaining seven muscles of the shoulder-joint; but before they are examined, it is necessary to describe the fascia which covers the whole of the extremity immediately under the skin.

This aponeurosis of the upper extremity surrounds all the muscles, and has between it and the skin the sub-cutaneous nerves and veins. It is derived from the spine of the scapula and infra spinatus muscle posteriorly, it is thin and ill defined in passing over the deltoid muscle, below which it becomes stronger from an addition of fibres given off from the insertion of the deltoid; internally it is continued from the cellular membrane of the axilla, strengthened by fibres from the tendons of the pectoralis, latissimus dorsi and teres major muscles. As it descends it adheres to the lateral ridges of the humerus, forming intermuscular tendons, which on the inner side reach from the insertion of the coraco brachialis to the internal condyle; and on the outer, from the insertion of the deltoid to the outer condyle. By this arrangement of attachment, the muscles of the fore part of the arm are separated from those of the back part; the two sets of muscles being thus inclosed in two separate bags of fascia. It is necessary to remark this arrangement, from the circumstance, that an accumulation of matter formed in one bag does not communicate with the other. This aponeurosis becomes thicker and dense as it approaches the elbow, where it completely surrounds the muscles, and is firmly attached to the condyles of the humerus and olecranon of the ulna.

Use.—The use of this aponeurosis is to support and strengthen the muscles, covering them both collectively amd individually, and preventing their displacement during action.

The *m. deltoides*—is a thick triangular muscle covering the upper part of the shoulder: it *arises* tendinous from the outer third of the clavicle, from the acromion and whole length of the inferior edge of the spinous process of the scapula. The clavicular fibres are directed downwards and backwards, the acromial fibres vertically downwards, and those arising from the spinous process pass obliquely downwards and forwards; the fibres thus converging unite in a tendon to be *inserted* into the rough surface situated immediately above the centre of the outer part of the os humeri. This muscle is composed of numerous large fasciculi, separated from each other by strong tendinous fibres; its outer surface is merely covered by skin, and a few fibres of the platysma myoides; it covers the supra, and a considerable portion of the infra spinatus muscles, and the insertion of the teres minor: in passing over the coracoid process of the scapula, it covers the insertion of the pectoralis minor, and the origins of the coraco brachialis muscle and short head of the biceps: its vertical or acromial fibres cover the insertion of the subscapularis, and the origin of the long head of the biceps, below which it passes over the tendinous insertion of the pectoralis major; and, at its point of insertion, its tendon is placed between the two origins of the brachialis internus: from the posterior edge of the deltoid, a strong fascia is given off, which covers the infra spinatus muscle, and which afterwards unites with the aponeurosis of the arm: the anterior edge of the deltoid is separated from the pectoralis major by the cephalic vein and humeral thoracic artery. The origin of this muscle corresponds with the insertion of the trapezius. In passing over the acromion scapulæ, the tendinous fibres are very numerous, and a bursa mucosa is found, which is placed between the muscle and capsular ligament of the shoulder-joint.

Use.—The anterior fibres of the deltoid draw the arm forwards, and assist in rotating the head of the humerus inwards; the posterior direct the arm backwards, and assist in rotating the head of the humerus outwards; while the middle fibres, whether acting singly or in conjunction with the others, raise the arm, drawing it upwards and outwards. When the arm is fixed, as in the attempt to raise a very heavy weight, it draws the scapula downwards.

The *m. supra spinatus*—*arises* from the fossa supra spinata, from the costa of the scapula situated above the spine, also from the tendon which covers this muscle: the fibres pass from these origins outwards and forwards through the acromial notch, beneath the triangular ligament, terminating in a tendon which passes over the neck of the scapula. It is intimately connected with the capsular ligament, and is *inserted* into the anterior depression on the upper part of the greater tubercle of the os humeri.

This muscle is covered posteriorly by a strong aponeurosis, and by the trapezius; superiorly by the deltoid and coraco acromial ligament: just as it passes through the acromial notch, it has the origin of the omo hyoideus muscle above it, and there is a bursa between its tendon and the neck of the scapula.

Use.—To assist the deltoid in raising and abducting the arm; it gives strength to the capsular ligament, and uniting with the upper part of the glenoid fibro-cartilaginous tissue, it assists in supporting that cartilage in the various motions of the head of the humerus.

The *m. infra spinatus*—*arises* from the fossa infra spinata, from the costa of the scapula below the spine, and from the fascia which passes off from the trapezius and deltoid muscles: from these origins the fibres converge towards the inferior part of the neck of the scapula, pass through the acromial notch, where it becomes tendinous, adhering to the capsular ligament which it strengthens; it is then *inserted* into the middle depression, on the upper part of the greater tubercle of the os humeri.

The upper posterior surface of this muscle is covered by the trapezius and deltoid, below by the latissimus dorsi, and in the intermediate space by fascia and common integument; the anterior surface is in contact with the dorsum of the scapula, and the capsular ligament; at the neck of the bone, it is furnished with a bursa. Its anterior edge is connected below with the origin of the teres major, and above with the teres minor through the medium of tendon; its posterior edge corresponds with the insertion of the rhomboideus major.

Use.—To assist in supporting the arm when raised by the action of the other muscles, to rotate the arm outwards, and to give strength to the capsular ligament.

The *m. teres minor—arises* from a slightly depressed surface between the two ridges of the anterior costa of the scapula, from its aponeurotic covering, and from the inter-muscular ligament; its fleshy fibres pass upwards and outwards, adhere firmly to the capsular ligament, and are *inserted* tendinous below the m. infra spinatus, into the inferior and outer depression, on the greater tubercle of the os humeri.

The origin of the teres minor is placed between the teres major which is below it, and the long head of the triceps which is above it; the infra spinatus being behind, and the subscapularis in front. The body of the muscle runs along the under edge of the infra spinatus, and is only covered by fascia and common integuments; its insertion lies under the deltoid, so as to be concealed by it. This muscle passes to its point of insertion behind the long head of the triceps, which separates it from the teres major; it also serves to strengthen the capsular ligament.

Use.—It cooperates with the infra spinatus in drawing the humerus downwards and backwards, and rotating the head of the bone outwards.

The *m. subscapularis*—*arises* from the whole of the fossa subscapularis and the costæ of the scapula; its fibres, separated into strong fasciculi by intermuscular tendons, form a triangular fleshy belly, converging towards the coracoid notch, through which it passes. It is *inserted* by a strong tendon intimately connected with the capsular ligament, passing through it to be inserted within the capsular ligament into the lesser tubercle of the os humeri.

The anterior surface of this muscle is covered by the serratus magnus; posteriorly, it is in contact with the whole of the interior surface or venter of the scapula; below, it is in contact with the origin of the teres major; its outer edge forms the upper and posterior boundary of the axilla, and is crossed by the axillary artery, and plexus of nerves; it is covered in front of its insertion by the coraco brachialis, deltoid and short head of the biceps muscles.

Use.—The subscapularis adducts the humerus, draws it downwards, and rotates the head of the bone inwards; and, with the three last-described muscles, strengthens the capsular ligament.

The *m. teres major*—*arises* from a triangular rough surface, situated upon the posterior face of the inferior angle of the scapula, and that portion of the bone left uncovered by the infra spinatus and teres minor; the muscle assumes a round lengthened form: its fibres ascend upwards and inwards, towards the arm, to be *inserted* by a broad thin tendon, united with that of the latissimus dorsi, into the inner and posterior edge of the bicipital groove of the os humeri.

The origin of this muscle is below but slightly connected with the infra spinatus; it is covered by the latissimus dorsi, where that muscle crosses the inferior angle of the scapula; above its origin is situated the teres minor; the belly of the muscle is placed in front of the long head of the triceps, separated by it from the teres minor, which is behind. Its tendon passes behind the coraco brachialis and short head of the biceps, in common with the tendon of the latissimus dorsi. These tendons are firmly united, excepting near the humerus, where a small bursa separates them. The relative position of these tendons with each other is, that the tendon of the latissimus dorsi is placed superior and anterior to that of the teres major; which latter, being broader, passes lower down along the edge of the bicipital groove. These united tendons form a part of the posterior boundary to the axilla, and have lying upon them the axillary vessels and nerves.

Use.—To rotate the arm inwards, and to direct it downwards and backwards; but should the humerus be fixed, it will then draw the scapula in the opposite directions.

The *m. coraco brachialis*—*arises* from the middle of the apex of the coracoid process of the scapula, and also from the inner edge of the tendon of the short head of the biceps; it forms a fleshy belly, which descends, becomes tendinous in the middle of the arm, and is *inserted* into a rough ridge at the middle and internal part of the humerus.

The origin of this muscle is situated between the short head of the biceps to its outer side, and the insertion of the pectoralis minor on its inner; the belly of the muscle then passing downwards and outwards, on the inner side of the biceps and behind the pectoralis major and deltoid, is perforated by the musculo cutaneous nerve. The insertion of the muscle takes place between the third head of the triceps and inner origin of the brachialis internus; and from which passes the intermuscular tendon to the internal condyle.

Use.—To raise and draw the arm forwards towards the body; and to rotate it outwards.

The nine muscles last described, conclude those which perform the motions of the shoulder-joint. The next set in the order of my arrangement, are those which belong to the elbow-joint; they are four in number, two flexors, and two extensors.

The *m. biceps cubiti—arises* by two heads from the scapula; the longer one by a thin tendon from the summit of the articular cavity, being continuous with the glenoid ligament; from thence, becoming contracted as it descends, the tendon passes through the capsular ligament of the shoulder-joint, is continued along the bicipital groove, after which it forms a thick fleshy belly. The shorter head arises tendinous from the outer side of the coracoid process of the scapula, in common with the coraco brachialis muscle; it almost immediately becomes fleshy, passing down to the middle of the arm, where it is intimately connected with the long head, forming one muscle which, just above the elbow, terminates in a strong flat tendon, which passes below the elbow to be *inserted* into the tubercle of the radius, having a large bursa between them. Below the elbow, previous to its insertion, it sends off an aponeurotic expansion which covers the fore arm anteriorly, and principally forms the common fascia.

The long head of the biceps is covered by the deltoid and capsular ligament of the shoulder-joint, which must be opened before it can be exposed, and in which it is covered by a reflection of the synovial membrane; while within the groove it lies between the pectoralis major and latissimus dorsi. The short head is also concealed by the deltoid and pectoralis major; the belly of the muscle is covered by the fascia and skin of the arm, and covers the coraco brachialis and brachialis internus muscles. The tendon continues superficially situated as it passes over the elbow; and it descends between the supinator radii longus on the outer side, and the pronator radii teres on the inner, to reach its point of insertion.

Use.—Principally to supine the hand; and although usually described as a flexor to the elbow-joint, it cannot assist in this motion until the brachialis internus has first brought the fore arm to an angle with the humerus; therefore this muscle might rather be considered as belonging to the radio-ulna articulation. Its long head tends to strengthen and support the shoulder-joint.

The *m. brachialis internus—arises* by a tendinous and fleshy origin on each side of the insertion of the deltoid muscle; it also arises fleshy from the remaining part of the anterior surface of the humerus: from these origins the muscle becomes broader, descends in front of the elbow-joint, adhering to the anterior ligament, and forms a strong tendon, which is *inserted* into a rough depression immediately below the coronoid process of the ulna.

The inner origin of this muscle lies between the insertions of the deltoid and coraco brachialis; the outer origin between the insertion of the deltoid and origin of the third head of the triceps: the belly of the muscle is covered by the biceps: the tendon passes down through the triangular space formed by the supinator radii longus, and pronator radii teres, and is here covered by the tendon of the biceps.

Use.—To flex the fore arm and to strengthen the elbow-joint.

The *m. triceps extensor cubiti*—*arises* by three distinct heads: the first, or long head, by a broad tendon from the anterior costa of the scapula, immediately below the glenoid cavity, and is intimately connected with the glenoid ligament; this head separates the teretes from each other: the second head arises on the outer and back part of the greater tubercle of the os humeri, commencing immediately below the point where the teres minor is inserted: the third head arises from the inner edge of the bicipital groove, commencing immediately below the insertion of the teres major. By the union of these origins, a thick fleshy muscle is formed in the middle of the posterior part of the humerus, being attached to the lateral ridges of the bone as far as the condyles; it then forms a strong thick tendon, which firmly unites to the posterior ligament of the elbow-joint, and is *inserted* principally into the olecranon, but descends also to be attached to the superior part of the posterior spine of the ulna.

This tendon sends off an aponeurotic expansion to assist in forming the general fascia of the fore arm. By attending to the relative position of the three heads of this muscle with respect to the teretes as described, the pupil readily comprehends their origins; the posterior surface of this muscle is covered by the fascia and common integuments, the anterior surface is in contact with the humerus, spiral nerve and superior profunda artery; and close to its insertion with the posterior ligament of the elbow-joint.

Use.—To extend the fore arm, and to carry it backwards and inwards when the long head is principally in action.

The *m. anconeus*—is usually described when speaking of the muscles arising from the external condyle; but according to my arrangement is now to be described as one of the extensors of the elbow-joint. It *arises* from the outer and inferior part of the external condyle of the humerus connected with the tendon of the triceps, it forms a triangular fleshy muscle, adheres to the posterior and external lateral ligaments of the elbow-joint; and passing over the superior radio ulnar articulation, where it has a bursa underneath it, is *inserted* into a flat roughened surface, below and to the outer side of the olecranon, and into the posterior spine of the ulna.

This muscle is covered posteriorly by the integuments and tendon of the triceps; anteriorly, it is in contact with the supinator radii brevis, and covers the annular ligament of the radius; it is situated between the olecranon and origin of the extensor carpi ulnaris.

Use.—To assist the triceps in extending the fore arm.

In the progress of dissection, we will now describe the fascia of the fore arm. It arises around the elbow-joint, proceeding anteriorly from the aponeurotic expansion of the tendon of the biceps; posteriorly, from the tendinous insertion of the triceps; and laterally, from the condyles and intermuscular tendons, which have already been described: from these sources it descends over the fore arm, forming a strong aponeurotic investment, which confines the muscles in their proper situation, and maintains the general contour of the arm. At the wrist it assists anteriorly in forming the ligamentum carpi annulare, which is rendered infinitely stronger by cross fibres proceeding from the bones of the carpus; posteriorly it forms the ligamentum carpi annulare dorsale, which is not so strong as the anterior carpal ligament, but is connected to the edges of the sulci, on the back part of the inferior extremity of the radius, forming them into fibrous canals for each of the extensor tendons. The superficial radial ulna and median veins pass up from the wrist to the elbow on the anterior and exterior surface of this fascia, together with branches of the cutaneous nerves; the interior surface of this fascia sends off processes, which dip between, and envelop the muscles of the fore arm.

From the function of the muscles of the fore arm, I have divided them into those of the radio ulnar articulations, those of the wrist-joint, and those common and proper to the fingers; but from their complicated connection with each other, considerable confusion would arise from their dissection in that order. It is therefore necessary, first, to classify them as the muscles placed between the radius and ulna, anteriorly, and posteriorly, and to subdivide each of them into two layers.

The muscles situated between the radius and ulna in front, are eight in number, principally arising from the internal condyle, and are divided into a superficial layer, consisting of five, and a deep-seated layer consisting of three muscles; of the five superficial, beginning from the outermost of them, we first expose the pronator radii teres of the radio ulnar articulation; next succeed the flexor carpi radialis and palmaris longus, two flexors of the wrist-joint; then the flexor sublimis perforatus, a muscle common to the fingers; and, lastly, the flexor carpi ulnaris, the third flexor of the wrist.

The *m. pronator radii teres—arises* tendinous and fleshy from the anterior and outer part of the internal condyle of the humerus, from the coronoid process of the ulna, and from the intermuscular fascia of the fore arm; from these origins the muscle proceeds downwards and obliquely outwards to be *inserted* tendinous into the asperity on the middle and outer part of the radius, immediately below the supinator radii brevis.

This muscle at its origin has the flexor carpi radialis on its inner side, with which it is blended, and the tendon of the biceps and brachialis internus on its outer side, as they are passing to their insertions, also the brachial artery and median nerve: the anterior surface is covered above by the skin and aponeurosis of the fore arm, at its insertion by the supinator radii longus, the radial extensors of the wrist, and the radial artery and nerve; it lies upon the brachialis internus and flexor sublimis muscles, median nerve and ulna artery.

Use.—To roll the radius upon the ulna, and thus to render the hand prone.

The *m. flexor carpi radialis—arises* narrow and tendinous from the fore part of the internal condyle of the humerus, also from the outer and back part of the coronoid process of the ulna, and from intermuscular tendon; it then proceeds fleshy downwards and obliquely outwards; and at the lower third of the fore arm it forms a strong tendon, which passes under the annular ligament, through a groove in the os trapezium, to be *inserted* into the base of the fore part of the metacarpal bone of the index finger.

At its origin this muscle is placed between the pronator radii teres on its outer side, and palmaris longus on its inner, between which muscles it passes downwards towards its insertion; and having gained the point of insertion of the pronator radii teres, it has to its radial side the supinator radii longus, and the radial artery and nerve; it is superficial in its whole course, until it passes into the hand, and there becomes covered by the annular ligament and muscles proper to the thumb; it lies upon the flexor sublimis, flexor longus pollici and wrist-joint.

Use.—With all the muscles inserted either into the bones of the carpus or metacarpus, to move the wrist-joint, which it flexes and slightly pronates.

The *m. palmaris longus—arises* from the fore part of the internal condyle of the humerus, laterally from the inter-muscular tendons, and in front from the fascia of the fore arm; it then forms a very short fleshy belly, which soon becomes tendinous, and passes downwards in the middle of the fore arm to be *inserted* into the annular ligament, or rather it may be said, to be attached partly to this ligament and partly passing over it, into the palm of the hand, forms the palmar facia, which terminates by four fasciculi at the digital extremities of the four metacarpal bones.

This muscle is sometimes wanting either on both or only one side; it is covered anteriorly by the common integuments and aponeurosis of the fore arm; it covers the flexor sublimis above; but below, while passing to the annular ligament, it gets to the outer side of the tendons of the flexor sublimis, and has the median nerve immediately behind it.

Use.—To fix the wrist-joint, to render tense the palmar fascia, and to protect the vessels and nerves situated in the palm of the hand.

The *m. flexor digitorum sublimis vel perforatus.*—Before this muscle can be dissected perfectly from its origins, the three last described muscles should be divided, and reflected towards their attachments, when the flexor sublimis muscle will be found to have four distinct origins from the bones of the upper extremity; first, from the internal condyle of the humerus, connected to the bone by tendon common to it and other muscles; secondly, from the root of the coronoid process of the ulna, immediately below the insertions of the brachialis internus muscle; thirdly, from the radius, just below the tubercle of that bone, and consequently close to the insertion of the biceps; fourthly and lastly, from the fore part of the radius, and middle third of its outer edge: from these different origins, the fibres unite to form one fleshy muscle, which soon sends off four tendons; two anterior of which are for the middle and ring fingers, and the two posterior for the index and little fingers: they pass underneath the annular ligament, between the fascia palmaris and tendons of the deep flexors of the fingers, till they arrive at the base of the first phalanx, where each of them becomes enclosed in a sheath or theca with a deep flexor tendon; thus they proceed to the second phalanx, where the flexor sublimis splits into two for the tendon of the flexor profundus to pass through it to be inserted into the extreme phalanx, while the tendon of the flexor sublimis is *inserted* into the anterior part of the second phalanx.

The origins of this muscle are covered by the pronator radii teres, flexor carpi radialis and palmaris longus; the belly of the muscle continues down the arm under the aponeurosis, behind the annular ligament and palmar fascia, to reach its four insertions, as already described. The muscle, in its course down the arm, lies upon the flexor profundus perforans, the flexor longus pollicis, the median nerve, the lumbricales muscles, and lastly, the phalanges of the fingers.

Use.—To bend the second phalanges of the fingers upon the first, and contribute to the contractions of the fingers as in grasping.

The *m. flexor carpi ulnaris.*—This is the last of the five muscles superficially situated between the radius and ulna in front; it *arises* from the inner side of the internal condyle of the humerus, and from the olecranon process of the ulna by a separate and distinct fasciculus, the ulna nerve and recurrent artery being situated between the two origins; it also arises aponeurotic from the posterior ridge of the ulna, running down as far as the pronator quadratus muscle, and from the fascia of the fore arm; from these tendinous origins, the fibres pass obliquely downwards and outwards, forming a semipenniform muscle, to be attached to a tendon which is *inserted* into the pisiform bone of the carpus; dividing here into two sets of fibres—the one of which crosses the ulna artery to be attached to the annular ligament, so as to form a foramen for the vessel; while the others pass downward to be connected with the palmar fascia.

This muscle is covered anteriorly by the fascia of the fore arm; it covers posteriorly the flexor digitorum perforans, the ulna artery and nerve, and the pronator quadratus muscle; its outer edge, at its origin, is united to the flexor perforatus; but as they descend they separate; and between them, or on the radial side of the flexor carpi ulnaris, is situated the ulna artery and nerve.

Use.—To flex the wrist-joint, and to direct the hand slightly inwards.

These five superficial muscles should now be cut through and reflected, to expose the three deeper seated; which comprise the flexor digitorum profundus vel perforans, common to the fingers; the flexor longus pollicis, proper to the thumb; and the pronator quadratus, a muscle of the radio-ulnar articulations.

The *m. flexor digitorum profundus vel perforans.*—This muscle *arises,* tendinous and fleshy, from the inner side of the upper extremity of the ulna, between the coronoid process and olecranon, from the root of the coronoid process surrounding the insertion of the brachialis internus muscle, from three superior fourths of the anterior surface of the ulna, reaching as far down as the attachment of the pronator quadratus, from the radial side of the ulna, and inner half of the interosseous ligament: it forms a strong fleshy muscle, terminating in four tendons, which pass under the annular ligament, where they are confined by surrounding cellular membrane. From this point they separate in the palm of the hand, and pass to the ligamentous sheaths of the fingers, perforating the tendons of the superficial flexors, to reach their *insertions* into the last phalanx of each finger.

This muscle is covered anteriorly by the flexor sublimis and flexor carpi ulnaris, the ulnar and median nerve, and the ulnar artery; it lies upon the fore and inner surfaces of the ulna, the interosseous ligament and vessels, the pronator quadratus, and the carpus and metacarpus.

The tendons of the flexor profundus and sublimis digitorum are confined in a peculiar tendinous sheath, given off from the anterior surface of the phalanges, and forming with them a complete canal, partly bony and partly fibrous. This canal is lubricated with synovia, and affords free motion to these tendons. It is composed of extremely short, dense, interlacing fibro cartilage, of a pearly hue, and firmly attached to the ridges of the interior surface of the phalanges. It commences by fibres given off from the inferior metacarpal ligament, are strongest and thickest opposite the middle of the first and second phalanges, and thinnest over the articulations, and terminate by an interlacement with the tendons of the flexor profundus, at their insertions in the third phalanges.

Use.—To bend the last, or ungual phalanx, on the second; if its contraction be still maintained, it will tend to bend the second on the first, and at last even produce flexion of the wrist joint.

The *m. flexor tertii internodii;* or, *longus pollicis manus.*—This muscle *arises* fleshy from the whole of the fore part of the radius situated between the insertion of the biceps into the tubercle above, and the attachment of the pronator quadratus within two inches of the lower extremity of the bone below, and from the outer side of the interosseous ligament; it has also a tendinons origin from the internal condyle, which, passing from the radial origin to the condyle, separates the superficial from the deep layer of muscles. The belly of this muscle has its fibres passing obliquely downwards to terminate in a tendon on its anterior surface, which tendon proceeds downwards, passes behind the annular ligament, then between the two origins of the flexor brevis pollicis and the two sesamoid bones, it reaches its *insertion* on the anterior part of the base of the extreme phalanx of the thumb.

This muscle lies to the outer side of the flexor profundus, covered by the flexor sublimis; its slip from the internal condyle, as has been already mentioned, separating them. Its tendon at the lower part of the arm covers the pronator quadratus, then passes under the annular ligament, and is concealed by the muscles of the thumb, and cannot be traced until the hand is dissected. The belly of the muscle lies upon the radius and interosseous ligament.

Use.—To flex the extreme phalanx of the thumb upon the second.

The *m. pronatus quadratus—arises,* on the inner side of the ulna, from a spaee about two inches in length, situated between the styloid process and lower attaehment of the flexor earpi ulnaris; from thence it proceeds transversely, adhering to the interosseous ligament, and is *inserted* into the lower and outer part of the radius, between the styloid proeess and attachment of the flexor longus pollieis.

Anteriorly all the tendons whieh pass to the hand cross this muscle; it lies upon the bones and interosseus ligament.

Use.—To roll the radius inwards upon the ulna, and thus to prone the hand.

The muscles situated between the radius and ulna, posteriorly, are eleven in number, which we may divide into a superfieial layer, eomposed of eleven, and into a deep-seated layer, composed of five muscles. Colleetively these muscles are extensors to the wrist and fingers, and supinators of the radio ulnar artieulations. The superfieial layers, six in number, all arise from the inferior extremity of the humerus.

The *m. supinator radii longus.*—This muscle *arises* from the external ridge of the os humeri, beginning immediately below the insertion of the deltoid, and eontinuing its origin to about two inehes of the external condyle, from whenee the extensor carpi radialis longior begins to arise, also from the outer intermuseular tendon; it then forms itself into a thick muscle, whieh beeomes narrower as it descends below the elbow-joint, and about the middle of the outer side of the fore arm it terminates in a tendon, at first flat, afterwards rounded, which proceeds along the outer side of the radius to the styloid process, into the anterior part of which it is *inserted.* At the base of the styloid process, the tendon sends off an aponeurotic expansion, which passes upon the posterior surfaee of the radius, so as to assist in forming the sulcus for the passage of the extensor primi and secundi internodii into a foramen. This muscle is only covered by the integuments and aponeurosis. Its origin is bounded in front by the brachialis internus; behind, by the triceps; above, by the deltoid; and below, by the extensor earpi radialis longior: as it passes over the joint, it lies upon the extensores earpi radialis longior and brevior; it then descends along the radius, between the flexor carpi radialis, whieh is anterior to it, and the extensor carpi radialis longior, which is posterior; and at its insertion the tendon is erossed by the extensors of the thumb. In the lower third of the arm, its tendon forms a guide to the radial artery, whieh is plaeed just on its ulna side, between it and the flexor carpi radialis.

Use.—To roll the radius outwards from the ulna, and to turn the hand supine; it also assists the flexors of the elbow-joint in bending the fore arm on the humerus; but is nevertheless classified as a muscle of the radio-ulnar articulations.

The *m. extensor carpi radialis longior*—*arises* from the lower part of the external ridge of the os humeri, between the origins of the supinator radii longus and the extensor carpi radialis brevior; it forms a short thick fleshy belly, which passes over the outer side of the elbow-joint, proceeds downwards upon the back part of the radius, at the middle of whieh it beeomes tendinous. The tendon eontinues downwards to the inferior and back part of the radius, where it passes through a sulcus, erosses the earpus to be *inserted* into a small tuberele in the posterior face of the metacarpal bone of the fore finger.

The humeral attaehment of this musele is placed between the brachialis internus in front, the triceps behind, the supinator radii longus above, and the extensor carpi radialis brevior below; on the outer side of the elbow it lies upon the extensor carpi radialis brevior and the supinator radii brevis, being eovered by the supinator radii longus; it passes down the fore arm, still eovered by this muscle, until it reaches the inferior extremity of the radius, where it passes underneath the extensor tendons of the thumb and dorsal annular ligament to gain its insertion.

Use.—To extend the wrist-joint by drawing the hand backwards, and assist in bending the fore arm; it is one of three extensors of the wrist-joint.

The *m. extensor carpi radialis brevior*—*arises* from the back part of the external condyle of the humerus and external lateral ligament, immediately below the origin of the extensor carpi radialis longior: it then forms a thick belly which passes over the superior radio ulnar articulation, continues down along the back part of the radius, and terminates in a round tendon, which proceeds through the same groove with the last described muscle, under the annular ligament, to be *inserted* into the posterior part of the base of the metacarpal bone of the middle finger.

This muscle at its origin lies between the extensor carpi radialis longior, which is above and anterior to it, and the extensor longus digitorum, which is behind it; then proceeds along the fore arm, partly covered by the extensor carpi radialis longior; its tendon runs through the same groove with it, under the extensors of the thumb; after which it separates from the tendon of the longior and passes under the indicator to its insertion.

Use.—The same as the last muscle; and is the second extensor proper to the wrist.

The *m. extensor digitorum communis*—*arises* from the external condyle by a tendon common to it, the extensor carpi radialis brevior and the extensor carpi ulnaris; a portion of this tendon runs down in the course of the inner side of the muscle, which it divides into fasciculi, the inner of which is by some anatomists termed the extensor proprius minimi digiti; a similar process of tendon runs down on the outer side of the muscle, and separates it from the extensor carpi radialis brevior. This muscle also arises posteriorly from the inner surface of the fascia of the fore arm; it then forms a fleshy belly of unequal thickness, but thickest in the centre; it passes downwards obliquely towards the inner part of the fore arm, and at the middle of its posterior surface divides into four distinct tendons which are connected with each other by cellular membrane, and together pass behind the ligamentum carpi dorsale through a groove common to them and the tendon of the extensor indicis. These tendons separate upon the dorsum of the carpus, and continue diverging to the articulation between the metacarpus and first phalanx, thence proceeding to be finally *inserted* into the extreme phalanx of each finger. While these tendons are situated on the mataearpus they are thin and broad, and connected with each other by small tendinous bands; while on the dorsal region of the first phalanges the tendons are thicker and more contracted, receiving the tendinous insertions of the lumbricales and interossei, and forming with them a continuation of aponeurosis, which covers the whole length of the back of the fingers.

The origin of the extensor digitorum communis is placed between the extensor carpi radialis brevior and extensor carpi ulnaris; as it proceeds down on the posterior surface of the arm it covers the supinator radii brevis, the extensores pollicis et indicis, posterior surface of the carpus, metacarpus, interossei dorsales, and the fingers. An interval is left on the outer side of the back of the arm, between this muscle and the extensor carpi radialis brevior, in which may be seen the extensores primi et secundi internodii pollicis.

Use.—To extend all the fingers; and, in its fullest contraction, to extend the hand upon the fore arm.

The *m. extensor carpi ulnaris*—*arises* fleshy and tendinous from the upper and back part of the outer condyle, between the extensor digitorum communis and anconeus; fleshy from the intermuscular tendon and fascia of the fore arm, and also from a considerable portion of the back part of the ulna: its fleshy belly terminates in a tendon which continues down on the back part of the ulna, then passes through a groove immediately on the outer side of the styloid process of that bone; from thence, under the annular ligaments, to be *inserted* into the back part of the metacarpal bone of the little finger.

This muscle is superficially situated; from its origin it passes down between the extensor digitorum communis and flexor carpi ulnaris, being separated however from the latter muscle by the internal ridge of the ulna.

Use.—To extend the wrist-joint, it is the third extensor to this articulation; but if singly in action it bends the hand laterally towards the ulna.

The *m. anconeus*—forms the sixth muscle superficially situated in this region; it has already been described together with those whose function is to give motion to the elbow-joint.

The progress of the dissection is best conducted by cutting through these six superficial muscles, and reflecting them towards their origins and insertions, in order to expose the five deep-seated muscles of this region, allowing them still to remain attached, as it gives to the student an opportunity to refer to their relative position.

Of the five deep-seated muscles, one is belonging to the radio ulnar articulations, three are proper to the thumb, and one proper to the index finger.

The *m. supinator radii brevis*—*arises* tendinous and fleshy from the back part of the external condyle of the humerus, and from a ridge on the outer side of the ulna, extending downwards from its lesser sigmoid cavity; from these origins the belly of the muscle winds around the superior radio ulnar articulation, being firmly attached, and indeed partly arising from its ligaments; it then passes to the anterior and inner surface of the radius, to be *inserted* into the upper third of this bone, in a space between the insertions of the biceps above, and the pronator radii teres below.

This muscle surrounds the superior radio ulnar articulation: it is covered on its outer side by the supinator radii longus, and the extensores carpi radiales; behind, by the extensor digitorum, extensor carpi ulnaris, and anconeus; in front by the brachialis internus and tendon of the biceps.

Use.—To roll the radius outwards, and supine the hand.

The *m. extensor primi internodii pollicis.*—This muscle is by most anatomists termed the extensor ossis metacarpi pollicis, but having already, when treating on osteology, given the reasons why the thumb should be considered as wanting a metacarpal bone and possessing three phalanges, it will be consistent with my views to describe this muscle as the extensor to the first phalanx of the thumb. It *arises* tendinous from a small spine situated on the back part of the ulna, immediately below the origin of the supinator radii brevis; fleshy from the interosseous ligament, and also fleshy from the radius, immediately below the insertion of the supinator radii brevis; from these origins the muscle forms a considerable belly which passes obliquely downwards and outwards to the inferior extremity of the radius, within about an inch of which it forms a tendon; that tendon proceeds through the outer groove on the back part of the radius, with the tendon of the extensor secundi internodii, being tied down by the posterior annular ligament, and lubricated by a bursa mucosa; on emanating from this groove, the tendon splits into two or three portions to be *inserted* into the outer part of the base of the first phalanx of the thumb, into the os trapezium, and is also usually connected with the abductor pollicis. The anterior surface of this muscle is in contact with the ulna, interosseous ligament, and radius, and below this with the tendons of the extensor radialis longior, and brevior; posteriorly, it is covered by the extensor longus digitorum, extensor carpi ulnaris, and extensor tertii internodii with which it is united.

Use.—To carry the thumb backwards, and also abduct it, from which circumstance, it is by many anatomists termed the abductor longus pollicis. It contributes in some measure to supine the hand.

The *m. extensor secundi internodii pollicis*—*arises* fleshy from the back part of the ulna, below its middle, and beneath the origin of the last described muscle; from the interosseous ligament, and from a considerable portion of the posterior surface of the lower third of the radius: it then forms a shorter and thinner belly than the preceding muscle; but taking the same direction, forms a slender tendon at the outer side of the lower extremity of the radius, passes through the same groove, but continuing further is *inserted* into the posterior part of the second phalanx of the thumb, sometimes reaching to the base of the third.

Its relative situation is much the same as that of the extensor primi internodii; but it covers in part the second as well as the first phalanx of the thumb.

Use.—To extend the second on the first phalanx, and to assist in the abduction of the thumb, and in the supination of the hand.

The *m. tertii internodii pollicis—arises* from the posterior surface of the ulna about the point of junction of its superior with its middle third, and also from a small portion of the interosseous ligament. It is then directed downwards and outwards, partly covers the origins of the extensor primi and secundii internodii, and forming a slender tendon at the lower part of the radius, passes through a groove of its own, which is placed between that for the extensors of the wrist, and the one for the common extensor tendons of the fingers, and the tendon of the extensor indicis. The tendon of the extensor tertii internodii then passes on the inner and posterior part of the first phalanx, reaches the second, where it is connected with the tendon of the secundi internodii muscle, and is *inserted* into the root of the third or extreme phalanx of the thumb.

This muscle lies upon the extensor primi and secundi internodii, upon the radius and ulna, upon the two radial extensors of the wrist, and upon the three phalanges of the thumb. It is covered by the extensor digitorum, extensor carpi ulnaris, and extensor indicis muscles.

Use.—It extends the third phalanx of the thumb upon the second, and in other respects assists in the action of the two muscles preceding it.

The *m. extensor indicis—arises* by fleshy and aponeurotic fibres from the posterior surface of the ulna, just on the inner side of the tertii internodii muscle, also from the interosseous ligament; it increases in size as it descends towards the hand, and immediately above the lower extremity of the radius it forms a slender tendon, which passes through the same groove with the tendons of the extensor digitorum, being united by one synovial membrane; arriving on the back of the hand, it passes to the index finger on the outer side of the slip of tendon from the extensor digitorum communis, and is *inserted* with it into the second and third phalanges. This muscle is covered by the extensor carpi ulnaris, and extensor digitorum communis, and it lies upon the ulna, interosseous ligament, the extensor tertii internodii, and radius and carpus.

Use.—To assist the tendon of the extensor digitorum to extend the fore finger; or, to act without the assistance of that muscle, as in pointing the fore finger.

The dissection of the palm of the hand may now proceed; but it is necessary to remark, that the insertion of several of the muscles already described are not proper to the hand, but yet, lying deeply under the palmar fascia, their final insertions cannot be examined, until the parts we are now about to describe are first dissected. Upon removing the skin from the palm of the hand, we shall find it thicker than on other parts of the body, excepting the sole of the foot, in consequence of the pressure to which it is constantly exposed. Immediately under the skin is found a strong aponeurotic expansion, which is termed the fascia palmaris, and upon it lies posteriorly a small cutaneous muscle.

The *m. palmaris brevis—arises* by thin separated fasciculi from the inner side of the anterior surface of the annular ligament, proceeds outwards in a transverse direction across the upper part of the palm of the hand, to be *inserted* into the skin which covers the ball of the thumb.

The skin covers the anterior surface of this muscle; and posteriorly it lies upon the muscles of the little finger, fascia palmaris, ulna artery and nerve.

The *fascia palmaris*—is extended from the annular ligament of the wrist, and from the tendon of the palmaris longus muscle by a narrow commencement; it proceeds downwards, its fibres diverging so as to cover the inferior surface of the palm of the hand, while it only covers the central third of the superior, leaving the bases of the metacarpal bones of the thumb and fore finger uncovered. It is attached to the inferior extremities of the four metacarpal bones, admitting the passage of the tendons to the fingers. This fascia is very dense and strong, and may be divided into four distinct fasciculi, which are connected by cross bands.

The anterior surface of this fascia is covered by the skin, palmaris brevis muscle, and superficial palmar arch of the ulnar artery; posteriorly it covers the tendons and muscles of the palm of the hand, to which it gives strength and support.

On removing the palmar fascia, we expose the muscles which are underneath it in the following order; those proper to the thumb, on the outer side; those proper to the little finger, on the inner side; and in the middle, the tendons of the long flexors common to the fingers, with the lumbricales attached to them.

The origin and insertion of the long flexors have already been described; but we have now, to complete the muscles connected with the function of flexion of the fingers, to dissect the third or short flexor.

The *m. lumbricales*—are four small muscles, which *arise* from the outer side of the tendons of the flexor profundus perforans muscle, immediately they have passed from under the ligamentum carpi annulare; and as those tendons, so do the lumbricales muscles diverge, and direct themselves towards the fingers, forming four distinct fasciculi. Beginning from the outer side, the first is attached to the radial side of the deep flexor of the index finger; the second to the ulnar side of the same tendon, and radial side of the flexor tendon of the middle finger; and the others in the same manner, so as to be attached to two tendons. From these attachments they proceed diverging to the metacarpo phalangeal articulations, and there become thin and tendinous, pass behind the first phalanx of each finger, and are *inserted* into the root of the first phalanx, and by a tendinous expansion which is common to these muscles, the extensor digitorum communis, and corresponding interossei, into the back part of all the phalanges of the fingers.

These small muscles are covered by the tendons of the flexor sublimis digitorum, deep palmar vessels and nerves, and posteriorly they lie upon the interossei.

Use.—To assist in flexing the first phalanx of the fingers, and when the tendons of the flexor perforatus are fixed, they can extend the first and middle phalanges. When they act in common with their corresponding interosseous muscle, they can adduct and abduct their respective fingers.

The muscles proper to the thumb are eight in number: three flexors, three extensors, an abductor and an adductor. Four of these have already been described, as they arise from the fore arm, viz., the flexor longus pollicis, or flexor tertii internodii, and the three extensors of the thumb; there are only left, therefore, in the palmar region two other flexors, the abductor, and the adductor muscles to be given. These muscles are covered by a thin aponeurosis.

The *m. abductor pollicis*—is somewhat of a triangular form *arising* by a broad tendinous and fleshy origin, from the anterior surface of the os scaphoides and trapezium, from a corresponding part of the ligamentum carpi annulare, and it is connected with the extensor primi internodii; from these attachments the muscle forms a thick belly, which passes outwards to be *inserted* tendinous into the radial side of the base of the second phalanx, sending off an aponeurotic expansion, which assists in covering the dorsal surface of the thumb.

This muscle is superficially situated, being only covered by the skin and a thin aponeurosis; it lies upon the two short flexors of the thumb.

Use.—Its use is implied by its name, separating the thumb from the fingers.

The *m. flexor primi internodii,* or *apponens pollicis*—*arises* fleshy and tendinous from the os naviculare, and from the os trapezium close to the groove in that bone for lodging the tendon of the flexor carpi radialis; it also arises from the ligamentum carpi annulare, from thence it descends to be *inserted* by short tendinous fibres along the whole length of the outer edge of the first phalanx.

This muscle is usually termed the flexor ossis metacarpi, as the antagonist to the extensor ossis metacarpi; but of both these muscles I have changed the name, for reasons already given.

Nearly the whole of this muscle is covered by the abductor pollicis, and it lies upon the flexor secundi internodii, and the articulation of the trapezium with the first phalanx.

Use.—To flex the first phalanx on the trapezium, and to direct the thumb towards the fingers and palm of the hand.

The *m. flexor secundi internodii,* or *flexor brevis pollicis* —*arises* by tendinous origins from the ossa unciforme, magnum, trapezoides, and trapezium, and also from the metacarpal bones of the ring, middle and fore fingers; the belly of this muscle, almost immediately after its origin, is separated into two fasciculi by the tendon of the flexor tertii internodii; but they unite below it, and descend to the lower extremity of the first phalanx, where they again separate to be *inserted* into the two sesamoid bones, which are connected by ligament and a continuation of the tendons of this muscle, with the fore part of the scond phalanx of the thumb.

This muscle is covered by the abductor pollicis, and more on its inner side by the flexor profundus digitorum and two first lumbricales muscles; it lies upon the outer interossei muscles and tendon of the flexor carpi radialis; it has to its outer side the flexor primi internodii, and on its inner the adductor pollicis.

Use.—To flex the second on the first phalanx.

The *m. adductor pollicis*—*arises* by a broad origin from a slight concavity on the anterior part of the metacarpal bone of the middle finger, between two of the interossei muscles; from these origins it passes transversely outwards, anterior to the metacarpal bone of the fore finger, its fibres converging as it proceeds is *inserted* tendinous into the inner side of the root of the second phalanx and inner sesamoid bone.

This muscle is concealed by the flexor profundus and lumbricales; posteriorly it is bounded by the two first interossei, abductor indicis, and skin; its outer edge runs along the inner edge of the flexor secundi internodii, or brevis pollicis.

Use.—To draw the thumb towards the fingers.

Of the two muscles proper to the index finger the extensor has been already described, as arising from the fore arm; but the origin and insertion of the one situated within the palm of the hand, has yet to be given.

The *m. abductor indicis*—*arises* tendinous and fleshy from the os trapezium, from the inner side of the lower half of the first phalanx of the thumb, and from the metacarpal bone of the fore finger; its fibres extend obliquely downwards and inwards, and terminate in a thin tendon which passes over the metacarpo phalangeal articulation, to be *inserted* into the outer side of the root of the first phalanx of the fore finger.

This muscle is superficially situated posteriorly; anteriorly it is covered by the adductor pollicis: these two muscles being separated from each other by the radial artery.

Use.—To abduct the fore finger, or to assist in adducting the thumb; it may be considered as a posterior interosseous muscle to the fore finger.

The three muscles proper to the little finger are placed within the palm of the hand, and are therefore now to be described.

The *m. abductor minimi digiti*—*arises* principally tendinous from the os pisiforme, and fleshy from the ligamentum carpi annulare; the belly of this muscle is large and flattened, is connected by intermuscular tendon with the flexor brevis minimi digiti, and passes along the metacarpal bone to reach the ulnar side of the root of the first phalanx, into which it is *inserted* by a narrow tendon, as well as into the tendinous expansion which covers the dorsal surface of the fingers.

The palmaris brevis, at its origin, partly covers this muscle.

Use.—To draw the first phalanx of the little finger from the other fingers, and assist in extending the second and third phalanges.

The *m. flexor brevis minimi digiti—arises* from the hamillary process of the unciform bone, and from the ligamentum carpi annulare; it is at first thin, then becomes broader, and terminates by a narrow tendon which is connected with that of the abductor muscle, and passes to be *inserted* into the root of the first phalanx of the little finger.

This muscle is covered by the palmaris brevis, lies on the radial side of the abductor minimi digiti, and on the ulna side of the adductor muscle, which it partly covers.

Use.—To flex the first phalanx of the little finger, and direct it towards the others.

The *m. adductor minimi digiti—arises* from the os unciforme, on the radial side and beneath the last muscle, and also from the ligamentum carpi annulare; it forms a thick fleshy muscle which passes to be *inserted* along the whole length of the radial side of the metacarpal bone of the little finger, and generally into the root of the first phalanx or sesamoid bone, when the little finger is furnished with them.

The adductor muscle is covered by the abductor and flexor brevis minimi digiti.

Use.—To draw the metacarpal bone of the little finger towards the palm of the hand; and by pressing it against the metacarpal bone of the ring finger, forms the palm into a concavity.

All these muscles which have just been described as belonging to the dissection of the palm of the hand, should now be carefully removed, and there will be exposed seven muscles occupying the spaces between the metacarpal bones, termed the interossei; which, being inserted into the tendons of the extensor longus digitorum, I have classified collectively as one of the five muscles common to the fingers, under the name of the short extensor to the fingers.

Four of these muscles will be found situated on the palmar, and three on the dorsal region of the hand. Those on the palm are termed the *interossei interni,* and are disposed in the following manner: two pass to be inserted into the index finger, one into the ring, and the fourth into the little finger. Beginning from the outer side, the first of these muscles to be dissected, is

The *m. prior indicis—arises* from the radial side of the metacarpal bone of the fore finger, and from a small portion of the first phalanx of the thumb; these fasciculi, being separated from each other, admit the passage of the radial artery between them; they soon, however, unite and pass to be *inserted* principally into the extensor tendon of the index finger, and also into the root of the first phalanx.

Posteriorly, this muscle is only covered by the skin of the back of the hand; anteriorly it is concealed by the first lumbricalis muscle, and the muscles proper to the thumb.

Use.—To assist in extending the fore finger, also to abduct it, and to draw the first phalanx of the thumb towards the metacarpal bone of the fore finger.

The *m. posterior indicis—arises* from the ulnar side of the metacarpal bone of the fore finger, as far upwards as the ligaments connecting that bone with the trapezoid; then passing downwards, between the metacarpal bones of the index and middle fingers, passes to be *inserted* into the extensor tendon and first phalanx of the fore finger.

This muscle is covered by the flexor brevis and adductor pollicis.

Use.—To assist in extending the fore finger; and, being extended, to adduct it.

The *m. prior annularis—arises* on the radial side of the metacarpal bone of the ring finger, along its whole length; and its tendon is *inserted* into the outer side of the first phalanx and extensor tendon of the ring finger.

It is covered by the lumbricales, and flexor profundus muscle.

Use.—To extend the ring finger, and draw it when extended towards the middle finger.

The *m. interosseus annularis—arises* from the root and radial side of the metacarpal bone of the little finger, and is *inserted* into the extensor tendon and outer side of the first phalanx of the same finger.

It is placed immediately underneath the flexor brevis minimi digiti.

Use.—To extend and draw the little finger towards the ring finger.

The *interossei externi*—are those muscles situated on the back of the hand, between the metacarpal bones; one on each side of the metacarpal bone of the middle finger and the third on the ulnar side of the ring finger. They each *arise* from two metacarpal bones, and are therefore sometimes called the interossei bicipetes.

The *m. prior medii digiti—arises* from the roots of the metacarpal bones of the index and middle fingers, and passes to be *inserted* into the extensor tendon of the middle finger and radial side of the first phalanx.

Its posterior surface is covered by the tendons of the extensor digitorum communis, and by an aponeurosis proceeding from one metacarpal bone to the other; and its anterior surface, which is much the narrower, is concealed by the adductor pollicis.

Use.—To extend and abduct the middle finger.

The *m. posterior medii digiti—arises* from the upper extremities of the metacarpal bones of the middle and ring fingers, and is *inserted* into the extensor tendon and ulnar side of the first phalanx of the middle finger.

It is covered posteriorly by the tendon of the extensor communis digitorum.

Use.—To extend and draw the middle finger towards the ring finger.

The *m. posterior annularis*—*arises* from the bases of the metacarpal bones of the ring and little fingers, and is *inserted* into the ulnar side of the ring finger.

It is covered posteriorly by the common extensor tendons, and anteriorly lies upon the interosseous muscle of the little finger.

Use.—To draw the ring finger towards the little finger.

The origins of most of these muscles are traversed by branches of arteries from the deep palmar arch.

Having given the origin and insertion of each muscle of the upper extremity, individually, it is important to consider the combined actions of the muscles of each joint, producing the extensive and various motions of the limb.

It may be well to recall to the recollection of the reader, that the upper extremity is principally connected to the body through the medium of those muscles which arise from the trunk, and are inserted into the clavicle and scapula; and that these muscles have the further office of fixing those bones before the arm can perform any powerful motion, while a *point d'appui* is always maintained by the attachment of the clavicles between the scapula and sternum. The shoulder is fixed by the equal action of seven muscles; two of which have already been described as serving to raise the scapula, three to carry it backwards, and two forwards.

By the separate action of these sets of muscles the scapula is either raised, drawn backwards or forwards, at the sâme time carrying the whole arm with it, and thereby increasing its field of motion. Independently of these direct movements, various combinations arise between the different sets of muscles, according to the varying points of direction in the movements of the scapula forwards, upwards, backwards and downwards: for instance, in reaching a book from a shelf above the head and in front of you, the action would be performed principally, so far as regards the scapula, by the two muscles above, and the two in front.

The shoulder-joint is formed by the attachment of the humerus to the scapula—a joint possessing the most extensive motion of any in the body; hence the necessity of its numerous muscles.

The humerus moves upon the scapula in every direction; but its principal movements are, forwards and upwards, downwards and backwards, outwards, inwards, and rotatory; and, by the combination of all these motions, circumduction. Each of these individual motions is performed by a particular set of muscles; while infinite varieties are formed by their multiplied combinations.

The motion forwards and upwards, or extension of the humerus, is performed by the acromial and clavicular fibres of the deltoid, supra spinatus, infra spinatus, coraco brachialis, subscapularis, pectoralis major (by its clavicular portion), assisted by the biceps, a muscle of the elbow-joint.

It is the deltoid, supra spinatus, coraco brachialis, and the clavicular portion of the pectoralis major, which first raise the humerus; while the infra spinatus, subscapularis and biceps unite to fix it in a raised position.

All these extensors of the shoulder-joint, must necessarily be put upon the stretch in the dislocation of the head of the humerus into the axilla.

The motion backwards and downwards, or flexion of the humerus, is performed by the posterior fibres of the deltoid, teres major, teres minor, latissimus dorsi, and by the long head of the triceps,—a muscle of the elbow-joint.

In dislocation of the head of the humerus into the axilla, the deltoid and long head of the triceps will be put upon the stretch, the teretes relaxed, while the latissimus is but little altered from its quiescent position.

The motion outwards, or abduction of the arm, is performed by the deltoid, supra spinatus, and infra spinatus, assisted, when carried from the side, by the subscapularis.

The first three of these muscles mentioned as abductors, have been before described as extensors of the arm; in that motion being in co-operation with the adductors.

In dislocation of the head of the humerus downwards and backwards upon the venter of the scapula, the subscapularis muscle is frequently lacerated.

The motion inwards, or adduction, is performed by the pectoralis major and latissimus dorsi; this motion being rendered more perfect by the action of the trapezius, rhomboidei, and pectoralis minor, uniting to draw the scapula with the arm in the inward direction.

In dislocation of the head of the humerus into the axilla, these muscles are put upon the stretch by the consequent abduction of the arm.

Rotation outwards is performed by the supra spinatus, infra spinatus, teres minor, posterior fibres of the deltoid, and coraco brachialis.

Rotation inwards is performed by the action of the subscapularis, teres major, and clavicular portion of the deltoid.

Circumduction is described by the motion of the arm forming a cone, the apex of which is at the shoulder-joint, and the base at the extremity of the fingers; it is produced by the combined operation of all the muscles of the shoulder-joint in succession.

The articulation of the elbow forming a ginlymus joint, its motions are in two directions only: which, being less varied than in enarthrodial articulations, is effected by a less numerous arrangement of muscles.

These motions are flexion and extension.

In flexion of the fore arm, both the radius and ulna move upon the humerus; and this motion is principally performed by the biceps, and brachialis internus muscles, as the flexors; the triceps and anconeus, as the extensors; three of which are inserted into the ulna. Indeed, I think it will be found upon a strict and attentive examination of the elbow-joint, either in reference to the articulation of the bones, to the attachment of the ligaments, or, to the function of its muscles, that the peculiar articulation of the radius with the humerus may be considered as passive, in relation to flexion and extension of the elbow-joint; and active only in relation to the superior radio ulnar articulation. Thus we may observe, that, during the performance of flexion and extension of the fore arm, the rotatory motion of the superior radio ulnar articulation may be continued as a separate and distinct action; proving, that, although the action relative to the elbow-joint is simultaneous, the function is for the distinct motion of a separate joint. And further, we may observe, that the principal strength of structure is maintained between the humerus and ulna, which are placed in a continued line with each other; while the radius diverges outwards from the elbow-joint to be connected with the carpus, and thus increases the range of motion of the hand.

The biceps muscle being attached to the radius, and not as the other three to the ulna, may be considered in its action for the purpose of drawing the head of the radius firmly upon the external condyle of the humerus, when powerful supination is required; and it is remarkable that the radius does not diverge from the ulna, until after the attachment of the biceps; by which construction, this point of insertion is placed in the line of direction in which the radius and ulna are capable of affording the greatest resistance. From these circumstances, the brachialis internus may be considered as the true flexor of the elbow; but when the radio ulnar articulation is in a state of supination, then the biceps is capable of acting, and adding considerable strength to the power of flexion. There are, however, several other muscles called into action, to maintain the elbow in a state of flexion; and these actions are variously modified according to the corresponding changes of exertions in the position of the limb. These muscles are the supinator radii longus, the flexor carpi radialis, the flexor carpi ulnaris, the palmaris longus, and pronator radii teres.

The extension of the elbow is produced by two muscles, the triceps and anconeus,—both of them inserted into the ulna. This is an additional proof, that the biceps is not to be considered as a flexor of the elbow, as it has no antagonist muscle in that use.

It should here be observed, as a circumstance of considerable surgical importance, that as the long head of the triceps acts in carrying the humerus backwards, as well as in extension of the fore arm; it is necessary to flex the humerus in dislocations of the ulna backwards, to lessen the action of the triceps on the ulna.

What is termed pronation and supination of the hand, are positions produced by the rotatory motion of the radius upon the ulna; the hand being articulated with the radius, and moving with that bone.

These rotations are produced by the following muscles: *pronators*—pronator radii teres, and the pronator quadratus, principally, assisted however by the palmaris longus, and flexor carpi ulnaris; the two last act most powerfully when the wrist-joint is extended: *supinators*—the supinator radii longus, supinator radii brevis, the extensors proper to the thumb, and the biceps brachii. The muscles of the thumb acting with the greatest force when the thumb is directed into the palm of the hand, and the biceps at such a time when forcible supination is required, attended with flexion of the fore arm; and the action of this muscle is further increased by flexion of the humerus.

The only rotatory motion of which the ulna is capable, is in common with, but not upon, the humerus.

The wrist-joint is capable of being flexed, or extended, and allows the motion of the hand either towards the radius or ulna.

The flexors are, the flexor carpi radialis, flexor carpi ulnaris, palmaris longus, flexor sublimis et profundus digitorum, and the flexor tertii internodii pollicis. The first three are to be considered as the principal flexors of the wrist-joint; and the others only as acting secondarily when their contraction is continued beyond flexion of the fingers.

The extensors are, the extensores carpi radialis longior et brevior, extensor carpi ulnaris, the extensor tertii internodii, extensor indicis, and the common extensors to the fingers; it is however the first three of these muscles only which are to be considered as acting primarily upon the wrist-joint.

The inflection of the hand towards the radius, is produced by the action of the extensor primi internodii, or extensor ossis metacarpi, extensor secundi internodii (usually termed the primi), extensor carpi radialis longior and brevior, and the flexor carpi radialis.

The inflection of the hand towards the ulna, is produced by the extensor carpi ulnaris, extensor digitorum communis, more especially by that portion of tendon which passes to the little finger, the flexor carpi ulnaris and the common flexors of the fingers.

The slight degree of motion which takes place between the bones of the carpus and metacarpus, does not appear to be under the control of muscular contraction, but rather to depend upon the application of some external force; and is not therefore now to be considered further than as an illustration of the propriety of naming the first bone of the thumb as a phalanx, rather than as a metacarpal bone.

The motions of the thumb are produced by eight muscles, a flexor and extensor proper to each phalanx, and an abductor and adductor common to the three.

Thus the motions of the first phalanx upon the os trapezium are, flexion—by the flexor primi internodii, or ossis metacarpi; extension—by the extensor primi internodii, or extensor ossis metacarpi; abduction and adduction — by corresponding muscles: besides a rotatory motion, which is produced by the quick and successive action of each of these muscles.

The second phalanx only moves upon the first, in flexion and extension; and is furnished therefore with the flexor and extensor secundi internodii.

The third phalanx, precisely in the same manner, has its flexor and extensor, termed the tertii internodii.

The first phalanx of each finger differs from that of the thumb, in being connected with a metacarpal instead of a carpal bone, and having no other motion upon it, than the phalanges enjoy upon each other; namely, flexion and extension, and some slight degree of abduction and adduction.

Flexion of the first phalanges of all the fingers, is produced by the lumbricales; of the second, by the flexor sublimis perforatus; and of the third, by the flexor profundus perforans.

Extension of each phalanx of all the fingers, is produced by the extensor digitorum communis and interossei; the latter muscle also acting as their abductor and adductor.

The first phalanx of the fore finger, has however a considerable motion towards the thumb by the action of the abductor indicis, a muscle proper to that bone, unless it be considered, as some anatomists are inclined to believe, one of the interossei muscles.

The first phalanx of the little finger has also a motion from three muscles proper to it, independent of the muscles common to the other fingers; but it does not enjoy a greater variety, although an independent motion.

Practical Remarks.

With respect to the fractures and dislocations of the bones of the upper extremity, I have already treated of them in my description of the bones and ligaments. The axilla is a large space bounded in front by the pectoralis major, behind by the latissimus dorsi and teres major, above by the shoulder-joint, below by the free edges of the pectoralis major and latissimus dorsi, on the outer side by the arm, and on the inner by the serratus magnus covering the thorax. This space is filled up by a large portion of cellular membrane, by absorbent glands, and by the axillary artery, vein and nerves. Operations are frequently required in this cavity, from the formation of abscesses in the cellular membrane, diseases of the glands, and from diseases and injury to the vessels. It is necessary, in these operations, whether opening an abscess or extirpating a diseased gland, to direct the knife towards the thorax, rather than towards the upper and posterior boundary of the axilla, in which direction the large vessels are situated, lying upon the tendons of the latissimus dorsi and teres major.

The brachial artery begins at the lower boundary of the axilla, and continues down along the inner side of the two upper thirds of the arm, after which it lies on the anterior surface of the inferior third; which course being remembered, the surgeon is thereby required to use particular caution in operating in that direction.

In abscesses under the fascia of the arm, attention must be paid to the precise situation of the matter, whether it be in the anterior or posterior fascial bag; if in the front cavity, the surgeon should direct his lancet anterior to the intermuscular tendons, leading on the outer side from the deltoid muscle to the external condyle, and on the inner side from the coraco brachialis to the internal condyle; the same respective attention is necessary if the abscess be situated in the posterior part of the arm.

The surgical remarks connected with venesection at the elbow, will be mentioned when treating of blood-vessels. Wounds of this part are of importance, from the proximity to the surface of its numerous vessels, and from the little protection the bones of this joint afford to them.

Wounds of the fore arm are of more importance on the anterior than the posterior surface, in consequence of the situation of the blood-vessels; and from their frequent division, the surgeon should be well acquainted with their relative position to the muscles. The operations necessary for securing these vessels will be given when treating of the arteries.

Abscesses of the hand are rendered dangerous from the thickness of the skin and fascia of the palm, which, being of so dense a nature, the process of ulceration goes on so slowly that violent constitutional symptoms arise from the confinement of the matter; and hence the necessity of early openings immediately fluctuation can be discovered.

LECTURE XVI.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Back.

HAVING described the muscles of the upper extremity, and in the progress of the dissection necessarily removed part of the muscles of the back, I shall now proceed to the remaining muscles of that region.

The subject being placed upon the abdomen, and the chest raised by blocks, the common integuments of the back should be dissected off, when a considerable layer of fascia will be exposed, giving more or less of a general covering to the subjacent muscles, and extending from the occiput to the pelvis. This aponeurotic expansion derives different names from the parts to which it is attached; hence it is termed the ligamentum nuchæ above, dorsal fascia in the middle, and lumbar fascia below; each of these parts requiring a separate description.

The ligamentum nuchæ, proceeds from the occiput to the sixth cervical vertebra; above it dips deeply down between the muscles, and separates those of the one side from the other; it seems to be formed of the aponeurotic origin of the muscles of this region, and assists in keeping the head erect, diminishing thereby the necessity of so great and constant a muscular action for that purpose. In quadrupeds it is much stronger and more distinct than in the human subject. From the termination of the ligamentum nuchæ, a broad aponeurosis expands laterally to the scapulæ, underneath the trapezii muscles, strengthening their fibres and binding down the muscles underneath; it reaches from the sixth cervical, to the fifth or sixth dorsal vertebra, dividing itself into two layers, so as to give a posterior as well as an anterior covering to the trapezii. The lumbar fascia, which is the strongest, consists of three distinct layers; the posterior of which can only be seen in this progress of dissection, but the deeper seated ones may be afterwards traced to their attachments.

The posterior layer of the fascia lumborum is attached to the apices of the spinous processes of the sacrum, and posterior labium of the crista of the ilium; from below it proceeds upwards, being attached to the spinous processes of all the lumbar and the last dorsal vertebra, and forms in this situation a common origin to the latissimus dorsi, serratus posticus inferior, and obliquus abdominis internus muscles.

This fascia, as it presents itself to view upon the back, is of an oval form, being broader in the centre than at its two extremities.

The second layer arises from the apices of the transverse processes of the lumbar vertebræ, in common with the transversalis abdominis, where it is connected with the posterior layer so as to inclose the sacro lumbalis and longissimus dorsi in a complete aponeurotic sheath, between the spinous and transverse processes of the vertebræ.

The third layer is attached to the roots of the transverse processes of the lumbar vertebræ, passes in front of the quadratus lumborum, being placed between it and the peritoneum, proceeds upwards as far as the inferior edge of the last rib, where it is attached to the ligamentum arcuatum, and below terminating on the crista ilii; this layer also proceeds to the apices of the transverse processes, and is there connected with the other two layers, so that at this point, which is at the posterior termination of the transversalis muscle, it may be said that the fascia lumborum divides into its three layers; the anterior one to be attached to the roots, the middle one to the apices of the transverse processes, and the posterior one to the spinous processes of all the lumbar vertebræ.

Use.—The use of the fascia lumborum is to give origin to muscles, and to afford a general support to the loins, by maintaining in some measure the equilibrium of the body without the aid of muscle.

This fascia being examined we may proceed to the dissection of the extensive mass of muscles which is found in this region of the body, and which, for facility of description, is divided into seven layers.

The first layer is composed of the m. trapezius and latissimus dorsi, which have already been described; the former attaching the scapula, and the latter the os humeri, to the trunk.

The second layer is composed of the rhomboidei and levator scapulæ; each of these have also been described as attaching the scapula to the trunk.

We now proceed to the third layer, which consists of two muscles, the serrati postici, both being muscles of respiration, and have not therefore in my arrangement been hitherto described.

The *m. serratus posticus superior*—*arises* by a tendon common to it, the rhomboidei, the trapezius, and the splenius muscles; from the spinous processes of the three inferior cervical, and the two or three superior dorsal vertebræ: from these origins it soon becomes muscular, and passes downwards and outwards to be *inserted* by distinct fleshy fibres into the second, third, fourth, and fifth ribs, anterior to their angles.

This thin square muscle is covered by the trapezius and rhomboideus; it covers part of the splenius, longissimus dorsi, sacro lumbalis, ribs, and external intercostal muscles.

Use.—To raise the ribs, and consequently to increase the capacity of the chest.

The *m. serratus posticus inferior*—*arises* by a broad thin tendon from the spinous processes of the three last dorsal and the three superior lumbar vertebræ, in connection with the fascia lumborum; this tendon proceeds obliquely upwards and outwards across the longissimus dorsi and sacro lumbalis, and then becomes fleshy, dividing into four distinct bundles which are *inserted* into the four inferior ribs; the inferior portion being the narrowest and the longest, extends as far as the cartilage of the last rib, while the others are inserted between the angles and the cartilages.

This thin broad muscle is covered by the latissimus dorsi; it rests upon the sacro lumbalis, longissimus dorsi, upon the three last ribs, and their corresponding external intercostal muscles.

Use.—To depress the lower ribs; to act therefore as an antagonist to the preceding muscle in diminishing the capacity of the chest.

These muscles being removed, the fourth layer will be exposed, consisting of a vast mass of muscle bounded above by the occiput, below by the pelvis, on the inner side by the spinous processes of the vertebræ, and on the outer side by the angles of the ribs, and are principally for the purpose of keeping the head and trunk erect; and many of them are muscles of violent expiration. It is necessary to subdivide this layer into three, consistent with my arrangement of dividing the muscles of the back into seven; although their precise origin is often arbitrary. The muscles which are completely exposed in this fourth layer are, below, the sacro lumbalis, longissimus dorsi, and spinalis dorsi; above, the splenius.

The *m. sacro lumbalis*—forms the outer boundary of the erector muscles of the spine; it *arises* by a broad tendon from the spinous processes and posterior part of the sacrum, from the posterior labium of the ilium, reaching nearly to the middle of its crista, also from the spinous and roots of the transverse processes of all the lumbar vertebræ; from these origins this muscle proceeds upwards and slightly outwards to be *inserted*, by long and thin tendons, into all the ribs, near their angles—the superior tendons being the longest. From the upper part of the six lower ribs, distinct bundles of fleshy fibres *arise*, which pass upwards to be attached to the inner side of this muscle; these are termed the musculi accessorii ad sacro lumbalem.

The *m. longissimus dorsi*—*arises* precisely by the same attachments with the last described muscle, passes inseparably with it to the last rib, where they diverge, to be *inserted* by tendinous and fleshy fibres into the lower edge of all the ribs, excepting the two last, in a space between their tubercles and angles, and into the transverse processes of all the dorsal vertebræ, by small double tendons; the insertions into the ribs proceed from the outer edge of the muscle, and into the transverse processes from the inner.

These muscles are situated underneath the latissimus dorsi, trapezius, rhomboidei, and serrati, and occupy a space between the spinous and transverse processes of the vertebræ.

Use.—To assist in preserving the erect position of the trunk, turning it to one side; or, in violent expiration, to diminish the capacity of the chest, by drawing down the ribs.

The *m. spinalis dorsi*—is exposed by turning the longissimus dorsi outwards from the spine; it forms the innermost fasciculi of the erector mass of muscle of the trunk, *arising* tendinous and fleshy from the spinous processes of the two superior lumbar, and the three inferior dorsal vertebræ; it proceeds upwards, in contact with the bones of the spine, to be *inserted* tendinous into the spinous processes of all the dorsal vertebræ above the ninth, excepting the first.

The situation of this muscle is between the longissimus dorsi and spinous processes of the vertebræ.

Use.—Together with the preceding to keep the trunk erect.

The *m. splenius*—*arises* tendinous from the spinous processes of the five inferior cervical and the four superior dorsal vertebræ; from these origins the fibres pass upwards and outwards, divide themselves into two portions—the upper one, which is by some anatomists termed the splenius capitis, to be *inserted* tendinous into the back part of the mastoid process of the temporal bone, and into the occipital bone immediately below the superior transverse ridge; the lower portion, frequently called the splenius colli, is *inserted* into the transverse processes of the three or four superior cervical vertebræ by distinct tendons.

The origin of this muscle is covered by the trapezius, rhomboidei, and serratus posticus superior.

The occipital insertion of this muscle is covered partly by the sterno cleido mastoideus, partly by the trapezius; the remaining portion being seen between them and the cervical insertion.

The cervical insertion is covered by the same muscles as its origin, and its tendons placed immediately behind the cervicalis ascendens and the levator scapulæ.

Use.—This muscle assists in keeping the head and cervical vertebræ erect, and to draw them backwards, either obliquely or directly as one or both muscles act.

The splenius should now be carefully removed to expose the muscles of the fifth layer of the back, which are situated on the upper part of the spine, and consequently covered by this muscle. This layer consists of the cervicalis ascendens, transversalis colli, trachelo mastoideus, and complexus; and are placed in the above order, beginning from the outer side and proceeding towards the inner or spinous processes.

The *m. cervicalis ascendens,* or more commonly called *descendens*—seems as if it were a continuation of the sacro lumbalis muscle, being directly continuous with its tendinous insertions, but is described as separately *arising* by distinct tendons from the upper edge of the four or five superior ribs; it soon forms thin fleshy fasciculi, which ascend, to be *inserted* by distinct tendons into the transverse processes of the fourth, fifth, and sixth cervical vertebræ.

The origin of this muscle is placed between the insertions of the sacro lumbalis on its outer side, and the longissimus dorsi on the inner, is covered by the rhomboideus; its insertion is placed between the splenius colli and levator scapulæ, and is the same, as far as refers to its attachment, as the origin of the scalenus anticus.

Use.—To turn the neck obliquely if one acts, or to steady the neck, and consequently the head, if they both act.

The *m. transversalis colli*—has the appearance of arising from the insertions of the longissimus dorsi, as the cervicalis ascendens does from the sacro lumbalis; but by dissection it will be found to *arise* on the inner side of the tendons of that muscle, from the transverse processes of the five superior dorsal vertebræ, by distinct fleshy and tendinous slips, and passes upwards to be *inserted* tendinous into the transverse processes of the five inferior cervical vertebræ.

The belly of this muscle lies between the cervicalis ascendens, which is situated on its outer side, and the trachelo mastoideus on its inner.

Use.—To bend the neck to one side, and direct it obliquely backwards.

The *m. trachelo mastoideus*—is a slender flattened muscle, which *arises*, partly tendinous and partly fleshy, from the transverse processes of the five inferior cervical and the two or three superior dorsal vertebræ. The fleshy fibres ascend vertically in the neck, and soon form one fleshy belly, which is directed outwards to be *inserted* tendinous into the posterior part of the mastoid process of the temporal bone.

This muscle is placed on the inner side of the transversalis colli, which partly covers its origin, and on the outer side of the complexus. It covers at its upper part, in its passage to the mastoid process, the obliqui capitis and the origin of the posterior belly of the digastricus. It is covered by the splenius and levator scapulæ.

Use.—To keep the head erect when both muscles act, and to draw it backwards, or to one side, if one only is in action.

The *m. complexus*—*arises* by tendinous and fleshy fibres from the transverse and articular processes of the four or five inferior cervical, and from the transverse processes of the seven superior dorsal vertebræ, gaining a fleshy fasciculus from the spinous process of the first dorsal vertebra; from these origins it soon forms one large fleshy muscle, which passes upwards, slightly converging towards the muscle of the opposite side, and is *inserted* into the rough surface on either side of the protuberance between the two transverse ridges of the occipital bone.

The complexus is covered successively by the trapezius, splenius, and trachelo mastoideus; it is situated between that muscle and the spine, being separated from its fellow by the spinous processes. It lies upon the semi-spinalis colli, upon the rectus capitis posticus major, and the obliqui; between this muscle and the semi-spinalis colli is placed the deep cervical branch of the subclavian artery, anastamosing with the occipital. A large portion of this muscle is seen between the splenius and the spine upon the removal of the trapezius.

Use.—To draw the head backwards, and to support it on the spine, also to rotate it; being in this action an auxiliary to the sterno cleido mastoideus of its own side.

The sixth layer of muscles of the back consist of the rectus capitis posticus major, the rectus capitis posticus minor, the obliquus superior, the obliquus inferior, the semi-spinalis colli, and the semi-spinalis dorsi.

The *m. rectus capitis posticus major*—is a triangular muscle, and is much broader above than below. It *arises* from the spinous process of the vertebra dentata, from whence it ascends, passing outwards to be *inserted* under the inferior transverse spine of the occiput, between the rectus capitis posticus minor, and the obliquus superior, the insertion of which partly covers it.

This muscle is situated between the occiput and the neck, is covered by the complexus, and lies upon the rectus minor, the arch of the atlas, the posterior circular ligament, and the vertebral artery.

Use.—To draw the head backwards, and to one side, if only one acts; directly backwards, if they both act.

The *m. rectus capitis posticus minor*—*arises* from a small tubercle upon the posterior arch of the atlas, which corresponds to the spinous process of the other vertebræ; from thence it passes upwards nearly vertically, becoming broader as it ascends, and is *inserted* into the occipital bone, in a space between the inferior transverse ridge and the foramen magnum.

Its posterior surface is partly covered by the rectus capitis posticus major; but a portion on the inner side is left uncovered by that muscle, and is in contact with the complexus; its anterior surface lies upon the posterior circular ligament, vertebral artery, and occipital bone.

Use.—To assist the preceding muscle in drawing the head backwards.

The *m. obliquus capitis superior—arises* tendinous from the posterior and upper part of the extremity of the transverse process of the first cervical vertebra; from this origin it forms an elongated muscle, which becomes broader as it ascends, and passes inwards to be *inserted* by tendinous fibres into the inferior transverse ridge of the occiput, sometimes reaching as far as the mastoid process.

This muscle is situated between the atlas and occiput; it is covered by the complexus and splenius; it covers the posterior circular ligament, the vertebral artery, and the occipital bone; at its insertion it conceals some of the fibres of the rectus capitis posticus major. A triangular space is seen between this muscle and the rectus capitis major, in which is placed the vertebral artery and suboccipital nerve.

Use.—When both muscles are in action, it draws the head backwards; it directs it, when singly, to that side on which the muscle is exerted.

The *m. obliquus capitis inferior—arises* tendinous and fleshy from the extremity of the spinous process of the second cervical vertebra; it then passes obliquely upwards, forwards, and outwards to be *inserted* by short tendinous fibres into the posterior and inferior surface of the transverse process of the atlas.

This muscle is covered by the complexus and trachelo mastoideus, excepting a small portion which is seen between them; its origin is covered by the origin of the rectus capitis posticus major.

Use.—To rotate the atlas, and with it the head upon the vertebra dentata, assisted by the splenius of the same side, and the sterno cleido mastoideus of the opposite.

The *m. semi-spinalis colli*—is not seen until the complexus is either raised or turned outwards. It *arises* by six tendons from the transverse processes of the six superior dorsal vertebræ; it ascends, passing obliquely inwards under the complexus, to be *inserted* into all the spinous processes of the cervical vertebræ, excepting the first and the last. Such are the attachments usually assigned by anatomists; but these are rendered difficult to dissect from their intimate union with other muscles.

This muscle is placed between the complexus and spinous processes of the vertebræ, to which it is attached; it is covered by the complexus, tendons of the longissimus dorsi, and in its middle part by the serratus superior.

Use.—To extend the neck, and to give it an oblique direction to either side, according to the action of either muscle.

The *m. semi-spinalis dorsi*—*arises* tendinous and fleshy from the transverse processes of the seventh, eighth, and ninth dorsal vertebræ, passes vertically upwards to be *inserted* by distinct tendons into the spinous processes of the five superior dorsal, and the two inferior cervical vertebræ.

The origin of this muscle is placed on the outer side of the insertions of the spinalis dorsi, and its upper attachments are on the inner side of the lower part of the semi-spinalis colli.

This muscle is covered by the longissimus dorsi.

Use.—To extend the spine either directly or obliquely backwards, depending on the action of one or both these muscles.

The seventh and last layer of the muscles of the back, consists of the multifidi spinæ, the interspinales, and the intertransversales.

The *m. multifidi spinæ*—extend from the sacrum to the second cervical vertebra, forming a chain of small muscles situated between the transverse and spinous processes. They pass upwards in an oblique direction, and gradually diminish in bulk as they ascend. They are of an unequal length, and intimately connected with each other; in some instances the origin and insertion extend only from one vertebra to the next, in others extend over two or three vertebræ, before they are inserted.

The multifidi spinæ *arise* from the spinous processes and posterior surface of the sacrum, and adjoining portion of the ilium; from the articular and transverse processes of all the lumbar, from the transverse processes of all the dorsal and cervical vertebræ, excepting the three uppermost; from these several origins, the fibres separate into distinct fasciculi to be *inserted* tendinous into the spinous processes of all the lumbar, dorsal, and cervical vertebræ, excepting the first.

These muscles are deeply seated, lying on the bones of the spine, and are covered by the semi-spinalis dorsi and the semi-spinalis colli.

Use.—To support and extend the spinal column obliquely, when the muscles of one side act; and also to give some slight rotatory motion of one vertebra upon another.

The *m. interspinales*—are small fasciculi of muscular fibres placed, as their name implies, between the spinous processes of all the vertebræ, and are divided into the interspinales cervicis, dorsi, et lumborum.

The *m. interspinales cervicis.*—In consequence of the bifurcation of the spinous processes of these vertebræ, the interspinal muscles are usually described as being double, a separate fasciculus being connected with each portion of the divided process; they are contracted at each extremity, and thickest in their centre. These muscles sometimes are continuous for the length of three or four vertebræ, and in other subjects distinct.

Use.—To draw the spinous processes of the cervical vertebræ towards each other, and consequently to extend the neck.

The *m. interspinales dorsi*—are much less distinct than the preceding muscles, and indeed are frequently wanting;

the lower five or six of the dorsal vertebræ have them usually the most distinct; when found, they are placed more by the sides of the spinous processes than at their apices, and seem as if they were portions of the attachment of other muscles rather than distinct muscles themselves.

Use.—The same as the last described.

The *m. interspinales lumborum*—are usually six in number; the first being between the spinous process of the last dorsal and the first lumbar vertebra, and the sixth between the sacrum and the last lumbar. In this region, as in the dorsal, they are placed more by the sides of the spinous processes than in the cervical region.

Having finished the muscles situated upon the posterior part of the spine, in order to complete the muscles of the spinal column, we will now proceed to those situated upon its anterior and lateral surfaces.

Deeply seated on the anterior surface of the neck are three muscles, which are exposed by removing the pharynx and larynx. The first of these—

The *m. longus colli.*—This muscle is peculiar from its origin being within the thorax, and passing out of the upper opening of the chest, extending from the third dorsal vertebra to the atlas. It *arises* tendinous and fleshy from the lateral surface of the bodies of the three superior dorsal vertebræ, and also from the anterior surface of the roots of the transverse processes of the four or five inferior cervical vertebræ; the fibres ascend obliquely inwards, adhering to the bones and intervertebral substances, and pass to be *inserted* tendinous and fleshy into the fore part of the bodies of all the vertebræ of the neck.

This muscle is covered by the pharynx, larynx, œsophagus, carotid sheath, and its contents; it lies upon the vertebræ and intervertebral substances; just where it emanates from the thorax it is placed on the inner side of the scalenus anticus muscle, between which a space is left which contains the vertebral artery, vein, and some filaments of the sympathetic nerve.

Use.—To bend the neck slightly forwards, and give some little rotatory motion of the atlas upon the second cervical vertebra.

The *m. rectus capitis anticus major.*—This muscle extends from the sixth cervical vertebra to the occiput; it *arises* tendinous from the transverse processes of the third, fourth, fifth and sixth cervical vertebræ, proceeds upwards and inwards, becoming broader as it ascends, and is *inserted* into the cuneiform process of the occipital bone, behind the attachment of the pharynx, reaching as far outwards as the condyloid process.

This muscle is covered by the carotid sheath and its contents, by the pharynx, larynx, and œsophagus; it lies partly upon the longus colli, rectus capitis anticus minor, and the articulations between the first and second cervical vertebræ; it is placed between the scaleni and longus colli.

Use.—To move the head slightly forwards, or laterally upon the atlas, according to the action of one or both muscles.

The *m. rectus capitis anticus minor*—is shorter and narrower than the preceding muscle; it *arises* tendinous below from the anterior part of the root of the transverse process of the atlas; from thence it expands as it ascends to be *inserted* into that portion of the cuneiform process of the occipital bone which forms the anterior margin of the foramen magnum, reaching as far laterally as the junction of the petrous portion of the temporal bone with the basilar process of the occipital.

It is covered by the rectus capitis anticus major; it covers the articulation between the atlas and occiput.

Use.—To assist the last described muscle in bringing the head forwards.

The muscles situated upon the lateral aspects of the spine, are the rectus capitis lateralis, the scaleni, the inter-transversales, and the quadratus lumborum; the latter muscle, however, I shall not describe, for the convenience of dissection, until treating of those arising from within the pelvis.

The *m. rectus capitis lateralis—arises* by a small tendon from the superior and anterior part of the transverse process of the atlas, aud ascends vertically to be *inserted* into a small process on the occipital bone, immediately behind the fossa jugularis.

The situation of this muscle is between the internal jugular vein, which is anterior to it; and the vertebral artery, which is behind it.

Use.—To incline the head laterally and slightly forwards.

The *m. scalenus anticus—arises* tendinous from the anterior part of the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ; it forms a thick fleshy muscle, which passes downwards to be *inserted* tendinous into a small tubercle situated upon the upper and anterior surface of the middle part of the first rib.

This muscle is deeply seated, and is covered by the sterno cleido mastoideus, and omo hyoideus muscles; its insertion is crossed by the subclavian vein, above which, it is also crossed by the superficial cervical artery; in the direction of its long axis there rests upon the muscle the phrenic nerve, and the ascending cervical artery; behind it, is placed the subclavian artery, so that the scalenus anticus muscle separates the subclavian artery from the subclavian vein; the outer side is bounded by the cervical nerves, as they are passing to form the axillary plexus, and the inner side by the vertebral artery.

Use.—To bend the cervical vertebræ laterally and forwards, and to assist in inspiration by raising the rib, fixing it as a point for the action of the intercostal muscles.

The *m. scalenus medius—arises* tendinous from the transverse processes of all the cervical vertebræ; these origins soon become fleshy, and pass downwards as one large muscle to be *inserted* into the upper and outer part of the first rib, about half an inch anterior to its angle, behind the subclavian artery.

This muscle is separated from the preceding, below, by the subclavian artery, and above, by the cervical nerves.

Use.—To bend the neck, and assist in inspiration with the anterior muscle; but it also assists in drawing the vertebral column a little backwards.

The *m. scalenus posticus—arises* tendinous from the posterior part of the transverse processes of the fifth and sixth, and sometimes from the fourth cervical vertebra; from these origins the muscle descends behind the former, and passes to be *inserted* into the obtuse edge of the second rib, between its tubercle and angle.

It is sometimes separated from the scalenus medius by some branches of the inferior cervical nerves; but more frequently the fibres of the two muscles are only distinct from each other at their insertions. This muscle is bounded posteriorly by the transversalis colli and splenius.

Use.—To raise the second rib during inspiration, and to extend the neck laterally.

Continuing downwards from the vertebral attachment of the rectus capitis lateralis to the sacrum, and situated between the transverse processes, are found muscles which are named, from their position, the intertransversales, and are subdivided into those of the neck, the back, and the loins.

The *m. intertransversales cervicis*—in consequence of the bifid termination of the transverse processes of the cervical vertebræ, are divided into an anterior and a posterior layer, proceeding from the first to the last vertebra of the neck: the attachment of the rectus capitis lateralis is continuous with these muscles.

Use.—To curve the spine laterally to the side on which they are in action.

The *m. intertransversales dorsi*—are much less distinct than in the cervical region, are usually larger in the lower dorsal vertebræ than the upper, as if they arose fleshy from the five or six inferior, to be inserted tendinous into the five or six upper vertebræ of the neck.

Use.—To draw, in some slight degree, the transverse processes of the vertebræ of the back towards each other.

The *m. intertransversales lumborum*—are intermediate in size, between those of the cervical and dorsal regions; are otherwise precisely similar to them; the fifth or lower one is attached to the lateral portion of the sacrum, and sacro lumbar ligament.

Use.—To draw the transverse processes of the lumbar vertebræ towards each other.

From the foregoing description of muscles of the spine, with their multiplied attachments, we perceive, that the motions of the spinal column are calculated to combine great strength with considerable variety of action. The inflections are, forwards, backwards, and laterally, together with intermediate modifications; in all of which the opposite muscles act as antagonists. For instance, in bending the body forwards, numerous muscles act in producing that motion; while at the same time, other muscles are called equally into action to prevent the column turning to either side, thereby fixing and supporting the bones. Again, in preserving the equilibrium of the body in all its motions, a vast number of muscles are called into action, merely to preserve its eliquibrium; hence there is almost an inconceivable variety in the combined actions of the muscles of the spinal column, all of which are more or less assisted, or are in connection with those of the trunk.

Before motion in any one part of the spinal column can take place, another portion must be fixed by a certain set of muscles, which are termed the fixors, and form a fulcrum of support for those muscles which are called into action as the motors of the part destined to be moved.

The motions of the spine may be considered with regard to its action generally, and to the actions of its particular regions.

Under the first consideration we may observe, that the erect position of the body is maintained by the simultaneous action of all those muscles which have been described as connected with the spine, on its anterior, posterior, and lateral regions; assisted also by the muscles of the abdomen, pelvis, and extremities.

The principal deviations from the erect position are, in the motions of the body forwards, backwards, or to either side.

When the body is bent forwards, the muscles of the lower extremities first act upon the pelvis, so as to form a fulcrum for the spinal column. The column itself is bent forwards by the rectus capitis anticus major, and minor, the longus colli, pectorales, serrati magni, abdominal muscles, and the psoæ; but it is to be remembered, that all these muscles do not immediately act upon the spinal column. For instance, the recti muscles of the head will only tend to flex the cervical region of the spine, after they have drawn the head to the full extent of their action forwards; while the longus colli, being only connected with the bones of the spine, act directly upon them. Again, the pectorales and serrati do not act upon the spine, until the ribs and upper extremities are first fixed by other muscles; in the same manner the abdominal muscles require the pelvis and ribs to combine in forming a fixed point, before they can act upon the spine; while the psoæ again act directly upon the column, when the pelvis forms a fixed point. To these muscles might be added several others; as, for instance, those placed between the sternum and os hyoides: but I shall not enumerate them in the general action of the spine, as their motions are very remote, although not wholly unconnected with it.

The spine is drawn backwards principally by the sacro lumbales, longissimi dorsi, spinales dorsi, semi-spinales dorsi, and multifidi spinæ; assisted by the trapezii, rhomboidei, latissimi dorsi, and serrati postici; the latter muscles acting through the medium of the upper extremities and ribs. It is essential to remember, that in the motions of the spine either forwards or backwards, the muscles in both regions are in reciprocal action. When the body is bent forwards, the posterior muscles act as antagonists, and modify the extent of action in the flexors; when the spine is bent backwards, then the flexors have a reciprocal action as antagonists to the extensors. The extensors of the spine are larger and more numerous than the flexors, having to support the greater weight of the head and viscera in front, and to counterbalance the preponderating direction of the body forwards.

The lateral directions of the spine are immediately produced by the recti capitis laterales, the scaleni, the intertransversales, and quadrati lumborum; assisted, however, by the flexors and extensors, when they act on one side only. The oblique insertion of the tendons adds considerable strength, as well as variety, in the directions of the lateral motions of the spinal column.

When the hand is grasping any fixed body firmly, the lateral motions of the spine are also assisted by the muscles of the upper extremity.

The rotatory motions of the spine are inconsiderable, and are even doubted by some physiologists; but in the lumbar region, the construction of the articular processes evidently admits of a slight rotatory motion, and may occur from the combined and successive action of the muscles of this part.

Practical Remarks.

Reflecting upon the construction of the vertebral column, and the various actions of its muscles in supporting the weight of the body, it is evident, that any deviation from the natural perpendicular direction of the spine would at once derange the natural position of the muscles, cause pressure on the spinal marrow, and consequent morbid action in the system.

Contortions of the spine most frequently occur from disease of the bone. In scrofula and rickets, their structure is softened and rendered less capable of supporting their superincumbent weight; the bones then yield according to the extent of the disease, throwing the body out of its natural position. The muscles of the two sides of the spine, in consequence, do not act equally; which tends materially to increase the contortion, by their constant endeavour to maintain the central line of gravity: a second curve is thus produced in an opposite direction to the primary deviation. These circumstances point out to the surgeon the necessity of his earliest attention, in diseases of the spine, to counteract their baneful effects: the symptoms of which seem naturally to indicate the propriety of using every means of improving the general health, of diminishing the superincumbent weight; and, from his knowledge of the physiology and functions of muscles, of making them, by judicious position, and perhaps motion, the active means of restoring the natural position of the bones.

With respect to the first indication, the improvement of the general health, it is necessary that the surgeon's attention should be directed to the state of the digestive organs, to the quality of food, and the salubrity of the air; mechanical means adopted to lessen superincumbent weight, as the inclined plane, &c., are of no avail whatever, and often are highly injurious, if at the same time the means of improving the general health be not attended to. With regard to position and motion, in relation to muscular action, no general plan can be laid down, as it must depend upon the peculiarities of each individual case.

Diseases of the spine frequently produce lumbar abscesses; and according to the direction which the matter takes between the layers of the lumbar fascia, they are named either lumbar, inguinal, or psoas: these are insidious in their progress, and often form large collections of matter, with very little concomitant constitutional derangement. As far as my experience extends, I doubt the propriety of opening these abscesses, as they are generally followed by hectic and dangerous symptoms.

As the most convenient progress of dissection, I shall now proceed to the remaining muscles connected with the thorax, which are expressly concerned in the function of respiration; while those which I have before given in connection with the chest, were only secondary in respiration, having to assist in other functions with which they are connected.

These muscles are, the intercostales, situated between the ribs; the triangularis sterni, on the inner surface of the sternum; the diaphragm, which separates the thorax from the abdominal cavity; and the quadratus lumborum, situated within the abdomen.

The m. intercostales, consist of twelve pairs on each side of the chest, and, with the ribs and sternum, form the parietes of that cavity; they are arranged in two layers, denominated the m. intercostales externi and interni.

The *m. intercostales externi*—are twelve in number, and proceed from the transverse processes of the vertebræ, as far forwards as the cartilage of each rib. They *arise* from the transverse processes of all the dorsal vertebræ, and from the acute edge of each superior rib; their fibres pass obliquely downwards and forwards,—those of the upper intercostal spaces being less oblique than those of the lower, and are also more oblique posteriorly than anteriorly; they are *inserted* into the upper obtuse edge of each inferior rib by short aponeurotic fibres, intimately connected with the periosteum as far as the cartilages of the ribs. The small fleshy bundles which arise from the transverse processes, are inserted partly into the rib connected with that vertebra, and partly into the next rib below; these are described as the *levatores costarum breviores et longiores*, and may be seen in the dissection of the muscles of the seventh layer of the back; but they are, in fact, merely the commencement of the intercostales externi.

These muscles are covered posteriorly by the serrati postici, longissimi dorsi, and sacro lumbales; anteriorly and above, by the pectorales; below, by the abdominal muscles; and in the middle, by the serrati magni: their internal surfaces are in contact with the pleura, from the tubercles of the ribs to their angles; and anterior to this they lie upon the internal intercostal muscles and vessels.

The *m. intercostales interni*—are twelve in number, and pass from before to behind, but with less obliquity than the external intercostal muscles. They *arise* from the lower edge of the cartilages of the ribs, commencing at their connection with the sternum, from the inferior edge of the body of each superior rib, extending as far as the angle, and pass downwards to be *inserted* into the upper edge of each inferior rib and cartilage. From the seventh to the eleventh rib, at about their centre, slips of the internal intercostal muscles, instead of being inserted into the rib immediately below, pass over it to be inserted into the second rib below; these muscles have received the name of *depressores costarum*, which evidently is an error; as, from the direction of their fibres, they cannot have a different action from the remaining portions of the internal intercostals.

The intercostal muscles decussate, forming a double layer in the centre of the ribs; and a single layer only from the sternum to the junction of the cartilages with the ribs before, and from the angle of the ribs to the transverse processes of the vertebræ behind.

The external surface of the internal intercostal muscles is covered by the preceding, as far as the cartilages of the ribs, and in their interspaces by the pectorales and abdominal muscles; the internal surface is lined by the pleura.

Use.—To elevate the ribs in conjunction with the external intercostal muscles. The decussation of these muscles, and the oblique direction of their fibres, serve to approximate the ribs more completely than if their fibres had passed perpendicularly; for this oblique direction allows of a greater length of muscular fibre, while their decussation balances a consequent loss of power, and at the same time maintains a perpendicular elevation of the ribs.

The *m. triangularis sterni*—is situated within the cavity of the chest, upon the posterior surface of the sternum; it *arises* tendinous and fleshy from the ensiform cartilage, and the edge of the lower half of the middle pair of the sternum; from thence it ascends, passing obliquely outwards, to be *inserted* tendinous into the cartilages of the third, fourth, fifth, and sometimes sixth ribs, corresponding precisely with the origin of the pectoralis minor, to which it is an antagonist in respiration.

This muscle is covered by the sternum, cartilages of the last four true ribs, internal intercostal muscles, and internal mammary artery; it rests upon the pleura.

Use.—To draw the ribs inwards and downward, it thus diminishes the capacity of the thorax in expiration.

The *diaphragma*—or transverse septum between the thorax and the abdomen, is composed of two fleshy portions with an intervening tendinous expansion. Its figure is circular, convex upon its upper surface, projecting into the chest; concave below, forming the upper boundary, and enlarging the cavity of the abdomen. Its direction is from above to below, and from before to behind; so as to render the posterior vertical dimensions of the chest much more capacious than the anterior. The anterior portion, or larger muscle, principally forms the partition between the two cavities. It *arises* from the posterior surface of the ensiform cartilage of the sternum, from the cartilages of the six or seven inferior ribs, and from the ligamentum arcuatum; from these attachments its fibres converge, and are *inserted* into a tendinous centre, which is termed the cordiform tendon of the diaphragm.

The lesser muscle, or abdominal portion of the diaphragm, *arises* tendinous on each side of the bodies of the four superior lumbar vertebræ, forming what are termed the cruræ of the diaphragm, of which the right is the larger and longer. These cruræ are at first separated from each other, leaving a narrow triangular aperture through which the aorta, vena azygos, and thoracic duct pass. The fibres of the lesser muscle then unite, decussate, again separate, and lastly, converge to be *inserted* into the cordiform tendon; leaving an elliptical opening between the points of decussation and insertion, for the passage of the œsophagus and par vagum.

The central, or cordiform tendon, is notched behind towards the vertebral column, and pointed anteriorly, so as more or less to resemble the form of a heart, from which it is has gained its name. Its fibres are of a tendinous lustre, and are more dense and distinct upon the upper than on the lower surface. A little to the right of its centre, and near the vertebral column, is an irregular triangular opening, through which the vena cava inferior passes, accompanied with filaments of the phrenic nerve. The four anterior fifths of the circumference of this tendon gives insertion to the larger muscle of the diaphragm, and the posterior fifth to the smaller muscle.

The upper convex surface of the diaphragm is covered by the pleura on each side, and by the pericardium in the centre, to which it is strongly attached; it also supports the base of the lungs. Its circumference anteriorly, is bounded by the triangularis sterni; laterally, by the internal intercostal muscles; and posteriorly, by the aorta, psoas, and quadratus lumborum muscles.

Its under surface is irregularly concave, and inclined forwards, its greatest concavity being over the liver; it is lined by peritoneum, and corresponds to the upper surfaces of the liver, stomach, spleen, pancreas, duodenum, kidneys, and capsulæ renales.

Use.—The diaphragm is the principal muscle of inspiration, and increases the capacity of the chest inferiorly, by having its convexity brought to a plane during its contraction; when it relaxes from this state, it is again forced upwards into the thorax by the pressure of the abdominal muscles, and the viscera underneath it. The œsophagus may be compressed by the contraction of the diaphragm, as it passes through its fleshy substance; while the aorta, vena cava, and other important organs, are protected from pressure by the arrangement of its tendinous fibres. Various phenomena arise from the action of this muscle upon the contents of the thoracic and abdominal cavities:—with respect to the lungs, sighing, yawning, coughing, laughing, sneezing, hiccough, and speaking; and in reference to the abdominal viscera, its motions contribute to the expulsion of the fœtus, urine, and fæces; and in consequence of its connection with the organs of digestion, and the chilopoetic viscera, it may assist in the performance of their functions.

The *m. quadratus lumborum.*—This muscle has already been named as one of those which are connected with the lateral aspects of the spine; but its origin and insertion was not described at the same time as the other muscles of that region, in consequence of its being situated within the abdominal cavity; but it may now be given consistently both with its function as a muscle of respiration, and with its situation.

It *arises* tendinous and fleshy from the posterior third of the middle labium of the ilium, and from the ilio lumbar ligament; from these origins the fleshy fibres ascend, to be *inserted* into the internal surface of the posterior half of the last rib, and into the transverse processes of the four superior lumbar, and the last dorsal vertebræ.

This muscle is placed between the diaphragm, which is anterior to, and partly covers it; and the sacro lumbalis, which is behind it: it is inclosed between the anterior and middle lamina of the fascia lumborum. The psoas magnus muscle, and the kidney are also anterior to it.

Use.—To bend the spine, and with it the thorax, laterally towards the pelvis; to draw down the last rib in expiration; and, if both muscles act, also to support the spine in the erect position of the body.

Having now described all the muscles which are connected with the ribs, without adverting particularly to their office in the function of respiration, it is necessary now to speak of their important action in the elevation and depression of those bones.

It may be observed, that respiration consists of the passage of a certain quantity of air into the lungs, termed inspiration; and the expulsion of a similar quantity, named expiration. The lungs, the receptacle of the air we breathe, are contained laterally within the thorax; the enlargement of which to admit of the increased volume of the lungs during inspiration, and its contraction during expiration, constitute the act of respiration. The motion of the ribs upon the spine, admit of the enlargement of the chest in the following manner:—Laterally, by the turning outwards, and elevation of the bodies of the ribs; anteriorly, by the thrusting forwards of the sternum, in consequence of the elevated ribs occupying a larger space; and the capacity of the chest is further increased from above to below, principally by the depression of the diaphragm, and by the elevation of the first ribs and sternum. With regard to the motion of the first rib upwards, considerable difference of opinion exists; and some physiologists consider that this rib is stationary, and forms a fixed point for the action of the intercostal muscles, and necessary elevation of the ribs below. On examination, however, it will be found, that the first rib possesses a more extensive motion than any of the others; for, while the lower ribs turn only upon their own axis on the spinal column, the first ribs have a distinct elevation throughout their whole length, being raised by the scalenus anticus and medius; and in connection with the sternum, their elevation is also assisted by the action of the sterno cleido mastoideus.

This fact is proved by the enlargement of the upper opening of the chest during inspiration; and still further by the form of the articulations, and distribution of the ligaments of the first rib, which admit of this particular motion, and differ from the articulations of the other ribs.

Respiration is performed by the action of two sets of muscles—those of inspiration and those of expiration.

The muscles of inspiration, are the intercostales, levatores costarum, diaphragma, sterno cleido mastoidei, scaleni, serrati postici superiores, serrati magni, subclavii, pectorales, latissimi dorsi, ascendentes cervicales, and the accessorii ad sacro lumbales.

The muscles of expiration, are the triangulares sterni, all the abdominal muscles, serrati postici inferiores, longissimi dorsi, sacro lumbales, quadrati lumborum; assisted by the cartilages of the ribs.

But under ordinary circumstances, these muscles of inpiration and expiration are not all called into action; hence they have been divided into the muscles of ordinary, forced, and violent respiration.

Muscles of Inspiration.

Ordinary.—Diaphragma.

Forced.—Intercostales, and levatores costarum.

Violent.—Sterno cleido mastoidei, scaleni, serrati postici superiores, serrati magni, subclavii, pectorales, latissimi dorsi, cervicales ascendentes, and accessorii ad sacro lumbales.

Muscles of Expiration.

Ordinary.—The relaxation of the diaphragm, and the cartilages of ribs.

Forced—Abdominal muscles.

Violent.—Triangulares sterni, serrati postici inferiores, longissimi dorsi, sacro lumbales, quadrati lumborum.

Practical Remarks.

Superficial wounds of the chest do not differ from superficial wounds of other parts of the body, excepting from its constant motion, which endangers a greater degree of inflammation and liability to the formation of abscess; hence the necessity of confining the motions of the ribs as much as possible, in all cases of severe injury.

When wounds penetrate the chest, there is danger of injuring the lungs, the heart, the large vessels, and even the œsophagus. These will be indicated by the passage of air, and small quantity of blood through the wound, accompanied with emphysema of the surrounding parts, of profuse hæmorrhage, if the heart or large vessels be wounded, or even of the passage of the contents of the œsophagus, when injury extends to that part.

The occurrence of emphysema more frequently follows fracture of the ribs and narrow stabs, than of more extensive wounds; because in the latter cases the air has a free exit, and is not forced into the cellular membrane of the surrounding parts. When an accumulation of air takes place between the pleura costalis and pulmonalis, the lung is not so capable of receiving air in each succeeding inspiration, which produces dyspnœa. It is doubtful, however, from experiments which have been made upon the subject, whether the admission of air necessarily produces a collapse of the lungs. Some authors recommend wounds into the chest to be left open, until such time as the wound of the lung has healed; so that the air may pass through it: and if there be any obstruction to its passage, and the difficulty of breathing increases to any alarming degree, the original wound of the parietes to be enlarged; or even a second opening to be made into the pleura.

When the accumulation of air takes place externally in the cellular membrane, scarifications and friction are the best means of relieving the symptoms produced, and are almost always efficient.

Should the lungs be wounded deeply, as indicated by the flow of blood from the wound, or its escape from coughing, the patient can only be saved by repeated blood-lettings, which must be carried to the utmost extent discretion could warrant.

Should extraneous bodies be lodged in the cavity of the chest, the opportunity should not be lost, if fainting should occur, of attempting their removal, even by enlarging the wound when it is necessary.

Protrusion of a portion of the lung may happen, though it is but of very rare occurrence; there are, however, cases on record in which mortification of the protruded part took place, and extirpation was resorted to with success: in others, the parts remaining healthy have been returned into the cavity of the chest, with an equally favourable result.

Empyema, or collection of pus within the chest, sometimes follows wounds of these parts, and is indicated by symptoms of the formation of matter, as in other parts of the body. If the abscess forms within the substance of the lungs, it is usually discharged through the bronchiæ; but it may open itself into the cavity of the pleura, and produce such difficulty of breathing, from its pressure on the lungs, as to render the operation of paracentesis thoracis necessary. The presence of matter within the cavity of the pleura, is known by the dull sound on tapping the chest with the fingers, as well as by the necessity which the patient has to lie on the diseased side, which relieves the lungs from the pressure of the matter ; such symptoms being corroborated, of course, by the previous history of the patient's symptoms.

When matter forms between the pleura costalis and the intercostal muscles, the pleura becomes considerably thickened, so as to form a barrier to its internal direction, and a fluctuating tumour is therefore felt externally ; usually however, unattended with discoloration of the skin. These abscesses should be opened as soon as fluctuation is discovered, to prevent its further extent, and the possibility of its escaping inwards. The openings should be made as much as possible in the most dependent direction, when the action of the lungs during respiration is sufficient to promote the discharge of the matter, in conjunction with the contraction of the cavity of the abscess. If this disease be attended with caries of the ribs, the cure is always difficult and protracted. Abscesses sometimes form behind the sternum in the anterior mediastinum, producing, besides those symptoms common to the formation of matter, pressure of the lungs, attended with difficulty of breathing ; and displacement of the heart, with irregularity of the pulse; such cases have been occasionally mistaken for aneurism ; but a proper diagnosis may be formed from a careful attention to previous symptoms, and from a minute examination of the tumour itself, under various positions of the body. These abscesses have been relieved, either by being opened between the cartilages of the ribs, or by a portion of the sternum being removed with a trephine. A case of this kind came under Sir Astley Cooper's notice, in which the patient, who was a surgeon, was considered by others, and himself believed to be dying of aneurism of the arch of the aorta ; as the tumour had a motion corresponding with the pulsation of the heart: Sir Astley Cooper, upon examination, discovered the nature of the case ; and gave instant relief, both to the body and mind of the patient, simply by puncturing the abscess with a lancet.

Remarks upon fractures of the bones of the chest have already been given, when treating on osteology.

LECTURE XVII.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Perinæum.

THE next part to be dissected, having finished the muscles which are connected with the ribs, and which perform the function of respiration, are the muscles of the perinæum, which are better displayed before, than after the dissection of the muscles of the lower extremities.

The perinæum is that part of the body which is placed between the anus and the organs of generation; it is of a triangular form; bounded above, or rather in front, in the erect posture of the body, by the scrotum in the male, and by the vulva in the female; by the anus, behind and below; and by the rami of the pubes and ischia, laterally. This space is much larger in the male than in the female; and of the former I shall first treat.

To dissect this part in the male, the subject should be placed and confined in precisely the same position, as for the operation for the stone; a sound should be passed into the bladder, the handle of this instrument being fastened with the penis attached to it at a right angle with the horizontal position of the trunk, and the scrotum being held to one side, the dissection may proceed.

But before the knife is used, the student should place an articulated pelvis in the same position with that of the subject; so that he may learn the precise relative bearing of the bony parts, with respect to each other; by the just knowledge of which, all the operations connected with this part can only be properly understood. Next, he should examine the perinæum of the subject, and he will find the skin of a darker colour than of other parts of the body, being continuous above (as the subject is now placed) with the skin of the scrotum; below, being much thinner, surrounds the anus; and, laterally, extends on the buttocks and thighs. In the centre, reaching from the anterior part of the anus, a dense and distinct line may be seen, which passes along the perinæum, scrotum, and under surface of the penis; this is termed the raphé, and divides the perinæum into symmetrical halves.

The integuments may next be removed by making an incision along the raphé, from the scrotum to the anus; and by dissecting the skin of each side outwards, and turning the flap towards the thigh, the sphincter ani muscle will be exposed, and the superficial fascia of the perinæum.

The *m. sphincter ani*—surrounds the anus, and is of an elliptical form; it *arises* by tendinous fibres from the extremity of the os coccygis; soon becomes fleshy; its fibres separate, pass around the sides of the extremity of the rectum, and unite at the front part of the bowel, to be *inserted* into the condensed cellular membrane and raphé of the perinæum; uniting with some of the fibres of the transversus perinæi and accelerator urinæ.

In the erect posture of the body, its inferior surface is covered by the skin of the perinæum; its upper with the levator ani, and superficial fascia; while, anteriorly, it unites with the accelerator urinæ, and transversus perinæi muscles.

Use.—To close the anus, and to draw the bulb of the urethra downwards and forwards; it is a muscle of the mixed class.

Above this muscle is found a condensed layer of cellular membrane, termed the fascia superficialis perinæi; and which is connected laterally, to the rami of the ischia and pubes; and, above, continuous with the superficial fascia of the scrotum and abdomen. The exact attachments of this fascia are most important, and should therefore be most accurately understood; as the direction of extravasated urine, and of matter in abscesses of the perinæum, is regulated by it. By minute examination, it will be found along the whole length of the rami of the pubes and ischia to be so firmly connected with the periosteum of those bones, as to prevent any fluid passing downwards towards the thighs; below the transversus perinæi muscle it dips backwards, to the tuberosities of the ischia, and becomes connected with the deep fascia of the perinæum; so that they are blended with each other: but above, where it passes to the scrotum and abdomen, it is so loosely connected with these parts, that if fluid be injected under the superficial fascia, it invariably makes its escape from the perinæum in those directions.

This fascia may now be removed, by making an incision in the direction of the raphé, and reflecting it outwards precisely in the same manner as described for the removal of the skin; when there will be exposed the accelerator urinæ in the mezian line, the erector penis laterally situated, on either side passing in the long axis of the perinæum, and the transversus perinæi muscles passing from the tuberosities of the ischia to the fore part of the anus, so as to divide the perinæum into an anterior and posterior region; and we shall find, that the anterior space contains the bulb of the urethra with its muscle, the erectors of the penis, and deeper seated the levator ani; while the posterior space contains the lower extremity of the rectum and its muscles.

The *m. accelerator urinæ*—is found in the mezian line of the anterior space between the anus and membranous portion of the urethra, surrounding the bulb. It may be considered as a single muscle divided into symmetrical halves, although generally described as a pair of muscles. It *arises* from the deep fascia of the perinæum, between the bulb of the urethra and the erector penis, posteriorly, being connected with the sphincter ani and transversi perinæi muscles; the muscle then proceeds forwards, covering the corpus spongiosum, and in the middle line is furnished with a raphé, so as to give the appearance of two muscles; laterally it is connected with the crura of the penis: it thus proceeds to the anterior part of the corpus spongiosum, where its fibres diverge (so as to leave an interval in which is seen the urethra,) to be *inserted* into the corpora cavernosa of the penis.

In the erect posture, the inferior surface of this muscle rests upon the superficial fascia of the perinæum; the upper surface is connected laterally with the crura of the penis, and the deep fascia of the perinæum, and in the middle line receives and supports the bulb of the urethra; anteriorly, it is lost upon the membranous covering of the corpora cavernosa of the penis; posteriorly, it is blended with the fibres of the sphincter ani, and transversus perinæi.

Use.—To compress and elevate the bulb of the urethra, so as to accelerate the ejection of the urine and sema.

The *m. erector penis*—is a thin flat muscle, *arising* tendinous and fleshy from the inner side of the tuberosity of the ischium, in connection with the inferior sacro sciatic ligament; the fibres proceed forwards, inwards, and upwards, converging towards those of the opposite side, adhering to the crus penis, and reaching the corpus cavernosum is *inserted* into the membranous investment of that body.

This muscle is bounded on its outer side, by the rami of the ischia and pubes; on its inner, by the accelerator urinæ, being separated from it by a considerable space of a triangular form, in which is found the artery of the perinæum, and a considerable quantity of fat; its inferior surface is covered by the superficial fascia; and its superior by the crus and corpus cavernosum penis.

Use.—To direct rather than erect the penis, unless it performs the latter office by preventing the return of the blood from the organ by the compression of the veins.

The *m. transversus perinæi*—is composed of a few fleshy fibres, which *arise* from the inner side of the tuberosity of the ischium, above the attachments of the erector penis; the fibres pass inwards and slightly forwards to be *inserted* into a tendinous line, situated between it and the muscle of the opposite side, and being also connected with the sphincter ani, and accelerator urinæ.

There are also in some subjects, a few muscular fibres *arising* from the ramus ischii, which proceed inwards above and deeper seated than the preceding muscle, to be *inserted* into the accelerator urinæ: this is termed the *m. transversus perinæi alter*, is usually wanting, but ought only to be considered as a part of the accelerator muscle.

This muscle is bounded, anteriorly, by the erector penis, and accelerator urinæ; posteriorly, by the sphincter ani; and externally, by the deep branch of the internal pudic artery.

Use.—To support the anus, and to dilate the bulb of the urethra.

The transversus perinæi muscle forms the base of a triangular space, which is bounded, externally, by the erector penis; internally, by the accelerator urinæ, and urethra; and, in front and above, by the corpus cavernosum. Through this space, on the left side of the patient, the knife is directed to the groove of the staff in the operation of lithotomy, as well as the lancet when plunged in opening deep perinæal abscesses.

The accelerator urinæ, and the erector penis, with the transversus perinæi of either side, should now be carefully removed from their attachments, so as to expose the deep perinæal fascia, which should now be examined.

The fascia perinæi profunda—is situated behind the preceding muscles; and by its junction with the triangular ligament of the pubes, separates the pelvis from the perinæum, being furnished however with two openings, through the upper of which the urethra passes, and the rectum through the lower. Tracing this fascia from below upwards, it will be found to begin from the inner side of the tuberosity of the ischium, there being connected with the posterior sacro sciatic ligament, covering the internal pudic artery; it proceeds upwards, attached to the ascending ramus of the ischium, and descending ramus of the pubes as far as the triangular ligament of the pubes, with which it joins on its under surface, passing across to the bones of the opposite side. This ligament forms, therefore, a deep-seated fascia behind the muscles of the perinæum, in the same manner as the superficial fascia does in front of them. Below, it forms a concave edge, which surrounds the upper surface of the rectum, reaching from the tuberosity of the ischium on one side to the other, at which points it is attached to the superficial fascia; its upper edge is also concave, surrounding the under surface of the membranous part of the urethra, leaving a space between it and the triangular ligament for the passage of that canal. There are yet two portions in connection with this ligament, which claim particular attention; these are given off from the point of junction between the triangular ligament and perinæal fascia, forming the passage for the urethra. The anterior, or perinæal lamina, proceeds along the bulb of the urethra, gives it support, and that peculiar glistening appearance it presents on dissection; it gradually loses itself by becoming more and more attenuated upon the corpora cavernosa. The posterior pelvic lamina passes backwards, surrounds the membranous part of the urethra, and covers the prostate gland, lining at the same time the inner surface of the levator ani; is continued as far as the spinous process of the ischium, where it is lost in the pelvic fascia. Above the membranous part of the urethra, it attaches the bladder to the pubes, and is there named the anterior ligament of the bladder.

The knowledge of the deep fascia of the perinæum is essential from the circumstance, that when the urethra is ruptured on its pelvic side, urine is extravasated into the cellular membrane within the pelvis; and extravasation of even a small quantity in this situation, is highly dangerous, from its proximity to the peritonæum; inflammation of which frequently occurs after operations and accidental ruptures of the urethra, causing, from its insidious progress, the most unexpected fatal terminations. Openings in the urethra on the anterior or perinæal side of this fascia, causes extravasation, attended with abscess, which shews itself in the perinæum, scrotum, and above the pubes. For the reasons already given, extravasations extend in these directions, and not within the cavity of the pelvis.

The circumstance most frequently rendering operations necessary in this part is, retention of urine from an impervious state of the urethra, through which instruments cannot be passed ; in such cases the urethra is obliged to be opened through the perinæum ; or the bladder punctured above the pubes, or per rectum. The detailed circumstances rendering such operations necessary, and the mode of performing them, more properly belong to a work professedly on surgery. I shall however here remark two cases of considerable peculiarity and practical utility.

In both of these cases insuperable retention of urine existed, attended with abscess in the perinæum; and, from the history of the cases, it was reasonable to suppose rupture of the urethra had occurred. In the first case, after the matter had been evacuated, I opened the urethra, passed a female catheter into the bladder, and drew off the urine ; having done this, I proceeded to pass a male catheter along the natural passage, and to my surprise found that the canal was pervious, and that the retention had been occasioned entirely by the pressure of the matter.

In the second case, the same insurmountable difficulty in the passage of the instrument occurred, and I was obliged to proceed as in the first case as far as the evacuation of the matter; after which the water was drawn off through the natural passage without further difficulty.

It appeared that, in these cases, the collection of matter pressed the urethra out of its natural course, and raising it above the opening in the triangular ligament caused, in conjunction with it, a duplication of the passage, which was insurmountable.

From this history, we learn the propriety, whenever an impervious state of the urethra is concomitant with abscess, of examining the state of the canal after the evacuation of the matter.

When the deep fascia of the perinæum is removed, the whole extent of—

The *m. levator ani*—is exposed. This muscle *arises* fleshy from the posterior part of the symphisis pubis, by thin tendinous fibres from the obturator fascia, beginning at the upper edge of the obturator foramen, reaching backwards along the ilium and ischium, as far as the spinous process of that bone; from these origins the fibres radiate, passing downwards and inwards towards the lower opening of the pelvis to be *inserted* into a tendinous raphé, formed by the union of the two muscles, which extends from the os coccygis to the anterior extremity of the rectum.

The anterior, or pubic portion of this muscle, surrounds the membranous portion of the urethra; and these fibres being somewhat distinct from the rest of the fibres of the levator ani, have been described by Mr. Wilson as a distinct muscle, under the name of the *compressor urethræ;* but they are too intimately connected with the levator ani to warrant their description as a separate muscle.

This muscle is of a funnel-like form, arising from the inner parietes of the pelvis, and descending, its fibres converge towards its fellow of the opposite side, principally filling up the lower opening of the pelvis; it lies between two layers of the deep perinæal fascia, the innermost of which separates this muscle from the rectum, membranous part of the urethra, prostate gland, and vesiculæ seminales; posteriorly it is in contact with the coccygeus muscle. Its anterior termination lies between the sphincter ani and the longitudinal muscular fibres of the rectum, forming some few circular fibres around the verge of the anus, which have been termed the internal sphincter.

Use.—To raise the rectum, and to draw it backwards towards the pelvis, when it has been protruded in the expulsion of the fæces; it also assists in propelling the urine and seminal fluid; and the anterior fibres which surround the membranous part of the urethra, perhaps, upon some occasions, act as a sphincter.

The *m. coccygeus*—is of a triangular form, situated behind the levator ani; it *arises* from the inner side of the spinous process of the ischium, and anterior sacro sciatic ligament, along which it runs, forming a thin fleshy belly; its fibres diverging to be *inserted,* tendinous and fleshy, into the side of the last bone of the sacrum, and the two upper of the os coccygis, immediately anterior to the attachment of the glutæus maximus.

This muscle is placed between the levator ani and gluteus maximus; its posterior surface is covered by the sacro sciatic ligaments ; its anterior corresponds to the rectum.

Use.—To draw the os coccygis forwards during the expulsion of the fæces.

The perinæum of the female differs from that of the male, chiefly in its size, which is little more than an inch in length, reaching from the posterior part of the vulva to the anus ; and, as in the male subject, the central line forms a raphé. The muscles are nearly similar, both in their origins and insertions; the exceptions are, that the *erector clitoridis,* which answers precisely to the erector penis, is *inserted* into the crura of the clitoris, as the latter is into the crura of the penis.

The *m. constrictor vaginæ*—surrounds the exterior opening of the vagina ; it *arises* from the crura of the clitoris, the fibres of one side diverging from the other, so as to surround the orifice of the vagina ; at the lower and posterior part of which they again converge to be *inserted* in the centre of the anterior part of the perinæum, in a point common to the sphincter ani and transversi perinæi.

Use.—To contract the orifice of the vagina.

Practical Remarks.

There are comparatively but few surgical remarks connected with this part in the female, in consequence of the large size, and the shortness of the meatus urinarius. Retention of urine is of very rare occurrence, unless produced by pressure in the progress of uterine gestation, or retroversion of the uterus. The perinæum is liable to injury from rupture, when it is not properly protected during difficult parturition ; and in these cases the patient is sometimes left in the most deplorable situation, from a permanent extravasation of urine, and even sometimes passage of the fæces through the part.

The anatomy of these parts will now lead us to the consideration of the more important operations for relief of those diseases to which the urinary and genital organs of the male are liable.

One of the most common of these operations to which a surgeon is called is, the introduction of an instrument for the dilatation of some contracted portion of the urinary canal; the mechanical aid employed may be either the soft and flexible waxen boujie, or a metallic instrument; but, whether the one or the other be employed, the surgeon's object should be to direct it in the natural course of the passage, which, under common circumstances, is readily performed. But should there from disease of the canal itself, or mechanical pressure from either abscess or any other morbid cause, be a difficulty in the passage of the instrument; the surgeon will, with patience and gentleness, prosecute the operation in the following manner.—The patient should be placed in the horizontal posture, with the knees bent, and the thighs separated; the point of the catheter is to be introduced into the urethra, the *handle* of the instrument being parallel with the horizontal position of the body; the *handle* should now be raised, and will be carried, unless there be obstruction in this portion of the urethra, readily to a right angle with the trunk—thereby arriving at the membranous portion of the canal: here very frequently an obstruction occurs, not however from any morbid cause, but from the manner in which the urethra is embraced by the deep fascia of the perinæum; an obstacle usually at once overcome, by drawing the penis forwards; thus straightening the canal, at the same time depressing the *handle* of the instrument; which forms the third step, and completes the operation by conveying the instrument into the bladder.

The wished for end is not always thus easily gained, from a morbid condition of the urethra, produced by permanent or spasmodic stricture; rupture of the urethra, with false passage (frequently the result of violent and hasty surgery); and enlargement of the prostate gland. As it is not however my province, from the nature of this work, to enter minutely into details, I will ouly, in generalising on this subject, deprecate in the strongest manner the determination too frequently formed of *foreing* an entry into the bladder.

In cases of retention of urine, where immediate relief is necessary, and after bleeding, purging, and warm-bath have been employed in vain, it is then for the surgeon's consideration, depending always upon the nature of the obstruction in the individual case, whether he should rely upon the possibility of a safe introduction of his catheter, or upon the more hazardous operation of opening the bladder.

An enlargement of the third lobe of the prostate seldom renders it necessary to puncture the bladder, although it frequently forms an obstinate obstruction to the introduction of a catheter; but which may be overcome by another step superadded to those recommended in the introduction of an instrument into the bladder under common circumstances. After the instrument has passed between the lateral lobes of the prostate gland, its further entry is resisted by the morbid development of the central third lobe; hence the necessity of the use of a longer and larger instrument; the depression of the *handle* of which, to a still further extent than before recommended, tilts the point over the new and obstructing growth.

The more important operation for the removal of urinary calculi from the bladder, will be described with the anatomy of the pelvic viscera; as a previous knowledge of the relative position of these organs is indispensable to a true understanding of the necessary steps in the performance of this operation.

LECTURE XVIII.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Lower Extremity.

THE muscles of the lower extremity may be divided into those of the hip-joint, those of the knee, those of the anele-joint, and those eommon and proper to the toes.

The same prineiple exists here as in the joints of other parts of the body,—namely, the museles moving eaeh joint are inserted into the bones next in eonneetion below. Thus the museles of the hip-joint are all inserted into the femur; the museles whieh move the knee, into the tibia and fibula; the muscles of the anele, into either the tarsus or metatarsus; and the museles eommon and proper to the toes, are inserted into the phalanges. Hence on looking at the insertion of any muscle, the student at onee knows the joint and funetion to whieh it belongs.

The museles of the hip-joint are fourteen in number; and although several of them eombine in the performanee of various aetions, still however they may be elassed as three flexors, three extensors and abductors, six rotators outwards, one rotator inwards, and one adduetor.

These museles are eovered by a strong faseia, whieh it is neeessary first to deseribe.

The *fascia lata.*—The anterior portion of this faseia has already been spoken of, in eonneetion with the anatomy of femoral hernia; but independent of its origin as deseribed from Poupart's ligament and the os ilium, it also arises, posteriorly, from the os saerum and eoeeygis, from the posterior part of the crista of the ilium, from the spinous process and tuberosity of the ischium, where it is connected with the sacro sciatic ligaments; from these origins it proceeds downwards upon the posterior part of the thigh, giving a covering to the muscles of this region; its edges are firmly attached throughout the whole length of the linea aspera, thus forming the posterior fascial bag: it is then continued to the heads of the tibia and fibula, where it is lost in the fascia of the leg. Anteriorly, the fascia lata arises from the anterior superior spinous process of the ilium, from the whole length of Poupart's ligament, from the pubes, Gimbernat's ligament, and linea ilio pectinea; from these origins it proceeds downwards, gives an anterior covering to the muscles of the thigh, and completes the anterior bag by passing to be attached to the whole length of the linea aspera, in common with the posterior bag, continuing downwards on the fore part of the thigh to the condyles and sides of the patella. Thus the muscles of the anterior region of the thigh, are completely separated from those of the posterior region by the intervention of this fascia; which dips internally, between the triceps adductor femoris, and vastus internus; externally, between the vastus externus and glutæus maximus above, and vastus externus and short head of the biceps below.

Besides these attachments of the fascia, it is right to mention, that it is thicker and stronger on the outer than on the inner part of the thigh; and that in several situations it splits to give a perfect envelopment to some of the muscles; particularly to the gluteus maximus, tensor vaginæ femoris which is inserted into it, and the sartorius.

The crescentic opening on the anterior part of this fascia, and other peculiarities of its anterior origins, have been already given when speaking of the parts connected with hernia.

Between this fascia and the common integuments, there is a dense cellular membrane, which is called the fascia superficialis; it forms a covering to femoral hernia, and has also been before described.

Practical Remarks.

In opening abscesses, attention must be paid to the situation of the matter, whether in the anterior or posterior bag, as they have no communication with each other; as was noticed in reference to the fascial coverings of the arm. In amputation above the knee, a skilful operator will make his first circular incision through the skin and superficial fascia only; for when the fascia lata is cut through at the same time, the retraction of the integument is effected with greater difficulty, in consequence of the much firmer attachment of the fascia to the muscles than to the skin.

We may now proceed to the dissection of the muscles of the hip-joint.

The three flexors are, the psoas, iliacus, and pectineus.

The *m. psoas magnus—arises* tendinous and fleshy from the sides of the bodies of the four superior lumbar, and the last dorsal vertebra, from the fore part of the roots of their transverse processes, and sometimes also from the head of the last rib; from these origins the muscle forms a thick belly, at first slightly contracted, enlarging as it descends, until it reaches the linea ilio pectinea, where it again contracts, becomes tendinous; and leaving the pelvis with the iliacus passes downwards into the thigh, to be *inserted* into the trochanter minor, extending a short distance below it.

Above, its origin is covered by the diaphragm, the psoas minor when it exists, and a small portion of the kidney; the lower portion of this muscle has resting upon it, the external iliac artery and vein; and the tendon, where it passes to be inserted, has the same vessels in front of it, under the name of femoral artery and vein. The inner edge of the muscle covers the bodies of the lumbar vertebræ, transmitting between its fibres a plexus of lumbar nerves; when the tendon gains the thigh, it is placed between the pectineus muscle on its inner, and the tendon of the iliacus on its outer side —these tendons being connected with the capsular ligament of the hip-joint.

Between the tendon of the psoas magnus, the pubes, and the capsular ligament of the hip-joint, a bursa is situated.

Use.—To flex the thigh upon the pelvis, and slightly to rotate it outwards; it serves to maintain the body in the erect posture, acting as an antagonist to the extensors of the spine. When the inferior extremities are fixed, it will bend the body forwards, or obliquely to one side, as both or one muscle act,

Although the psoas parvus is not a muscle destined to move the hip-joint, yet from its situation, and for the facility of dissection, it is impossible to describe it at a more convenient time.

The *m. psoas parvus.*—This muscle does not always exist: when present it *arises* from the sides of the bodies of the last dorsal and first lumbar vertebra; it forms a fleshy belly which ceases opposite to the fourth lumbar vertebra, terminating in a flat tendon, which becoming broader as it descends, passes to be *inserted* into the linea ilio pectinea, at the point of junction of the ilium with the pubes; it also sends an aponeurotic expansion, which is connected at Poupart's ligament with the fascia lata.

It is situated anteriorly, and to the inner side of the psoas magnus; its origin is covered partly by the diaphragm, and renal vessels, and plexus of nerves, and at its insertion by the external iliac vessels.

Use.—When the pelvis is fixed, to flex the trunk; or bend it obliquely, when one muscle only is in action.

The *m. iliacus internus*—is a flat, triangular, radiated muscle, filling up the venter of the ilium; it *arises* fleshy from the transverse process of the last dorsal vertebra, from the ilio lumbar ligament, from the inner labium of the crista of the ilium, reaching from the sacro iliac symphisis along its two posterior thirds; from the greater part of the venter of the ilium, and also from its anterior and inferior spinous processes; being below this attached to the capsular ligament of the hip-joint.

From these origins its fibres converge, and pass outwards under the crural arch with the psoas magnus; terminating in a tendon firmly united to, and *inserted* in common with the tendons of the psoas magnus, into the lesser trochanter, between the vastus internus and pectinæus.

This muscle covers the iliac fossa, the articulations of the femur, and the upper part of the origin of the rectus; it is covered above the crural arch, within the pelvis, by the cœcum on the right, and the sigmoid flexion of the colon on the left; below the crural arch, it is bounded by the sartorius on its outer side, by the pectinæus and crural vessels and nerves on its inner side. The cellular membrane in the bend of the groin separates it from the crural aponeurosis anteriorly.

Use.—To flex the trunk and pelvis, or to bend the thigh directly forwards.

The *m. pectineus*—is a flattened triangular muscle, *arising* from the pubes, in a space extending from the spine of that bone outwards and backwards, along the linea ilio pectinea; being attached to the fore part of Gimbernat's ligament; from thence it descends, passing in front of the obturator foramen, with an obliquity downwards, backwards, and outwards, to be *inserted* by a flat thin tendon into the linea aspera, immediately below the trochanter minor, and behind the vastus internus.

This muscle is covered by the femoral vessels, and anterior crural nerve, which are however separated from it by an interval which is filled up with cellular membrane; it lies upon the pubes, obturator externus, and origin of the adductor brevis muscle; its inner edge is covered by the adductor longus, and its outer edge is parallel with the psoas magnus; it is inserted immediately below the psoas and iliacus, and above the adductor brevis.

Use.—This muscle flexes the thigh upon the pelvis, slightly assists in the adduction of the limb, and performs in some measure the office of a rotator outwards.—The principal action, however, of the three muscles of the hip-joint just enumerated, are, to flex the thigh upon the pelvis; and are termed therefore the three progressors, being particularly in action during progressive motion.

These muscles are covered on their anterior surfaces by the fascia iliaca, which passes down to form the posterior layer of the sheath of the femoral vessels; being above, at the diaphragm, connected with the fascia transversalis, and on the outer edge of the iliacus muscle, with the anterior layer of the fascia lumborum.

The progress of the dissection now requires that the glutei muscles, which are the extensors and abductors of the hip, and being exterior to so many other muscles, should next be described.

For this purpose the subject must be placed prone, and the pelvis raised so as to place these muscles in a comparative state of extension. The fibres of the gluteus maximus will be exposed in their course by an incision made from the sacro iliac symphisis to the trochanter major.

The *m. glutæus maximus*—*arises* from the posterior third of the outer labium of the crista of the ilium, from the posterior sacro iliac ligament, from a tendon common to it, the latissimus dorsi and sacro lumbalis, from the outer side of the sacrum, and side of the sacro coccygeal ligament, from the side of the os coccygis, and from the posterior sacro sciatic ligament; from these different origins the fibres pass obliquely outwards, downwards, and forwards, forming a strong thick fleshy muscle of large bundles of fasciculi, distinctly separated by cellular membrane; passes over the trochanter major, where it is furnished with a bursa mucosa, and over the tuberosity of the ischium; after which its fibres, being firmly attached to the fascia lata, converge to be *inserted* tendinous into the linea aspera, beginning immediately below the trochanter, and extending three inches down that line; the tendon being furnished with one or two small bursæ between it and the femur.

The glutæus maximus is superficial, and forms the greater bulk of the nates; its outer surface is covered by the integuments, and a very thin layer of fascia lata. It covers at its upper part portions of the ilium, sacrum, and os coccygis, posterior half of the glutæus medius, pyriformis, gemini, and obturator internus muscles; lower down it covers the trochanter major on the outer side where it is connected with the tensor vaginæ femoris, the tuberosity of the ischium on the inner side, covering the origin of those muscles of the knee-joint which arise from that portion of bone, namely, the semimembranosus, semitendinosus, and biceps; and between the trochanter and tuberosity it covers the ischiatic nerve and vessels, the quadratus femoris, and adductor magnus muscle.

Use.—To extend the thigh by carrying it backwards, and slightly to rotate it outwards; the two act forcibly to maintain the equilibrium of the body in its erect and bent positions.

On the raising of the glutæus maximus, which should be left attached by its tendinous insertion, you expose

The *m. glutæus medius*—which *arises* from the outer edge of the anterior and superior spinous process of the ilium, and from the dorsum of that bone between the crista and the semilunar ridge, marking the origin of the glutæus minimus, reaching as far back as the posterior and superior spine; also from a rough ridge, extending between the two anterior spinous processes: from these several origins, the fibres converge, forming a thick triangular muscle, which passes to be *inserted* into the upper and outer part of the great trochanter.

The posterior half of the glutæus medius is covered by the glutæus maximus; the anterior half by the fascia lata, from which some of its fibres are said to arise; it covers the glutæus minimus, and the deep branches of the glutæal artery; its inferior edge is running parallel with the pyriform muscle, crossing it at its point of insertion, where a bursa mucosa is placed.

Use.—Principally to abduct the thigh; its posterior fibres tend to rotate the thigh outwards, and the anterior fibres to rotate the thigh forcibly inwards; while the whole muscle maintains the equilibrium of the body in the erect position.

This muscle should now be raised from its origin to expose

The *m. glutæus minimus*—which *arises* by short aponeuroses from a semilunar line on the dorsum of the ilium, extending from the anterior and inferior spinous process backwards to the ischiatic notch ; and also from that portion of the dorsum between this ridge and the acetabulum ; it forms a thin triangular muscle, its fibres converging towards a tendon arising more from its external than its internal surface, and which is *inserted* into the upper anterior part of the trochanter major ; posteriorly being blended with the tendon of the gluteus medius.

The insertion of this muscle is usually furnished with a bursa mucosa. It is entirely covered by the gluteus medius ; it lies upon the lower part of the dorsum of the ilium, the capsular ligament of the hip-joint, and the tendinous origin of the rectus femoris.

Use.—The same as the preceding muscle, except in being more powerful as a rotator of the thigh-bone inwards.

The *m. pyriformis*—is a muscle *arising* from within the pelvis by distinct tendinous and fleshy origins from the second, third, and fourth pieces of the sacrum, just on the outer side of the anterior sacral foramina ; it is also partly connected with the posterior sacro sciatic ligament : from these origins it proceeds outwards; leaves the pelvis by passing through the ischiatic notch, and immediately forms a tendon, which passes to be *inserted* into the upper and anterior part of the fossa situated on the inner side of the trochanter major. The fibres of the fleshy origin of this muscle, are sometimes separated by branches of the lumbar plexus passing to form the sciatic nerve.

The posterior surface of the pyriformis covers the sacrum, and gluteus maximus ; anteriorly, it is covered by the rectum, lumbar nerves, and internal iliac vessels ; it is bounded above, by the gluteus medius; below, by the superior geminus—between which two muscles its tendon is inserted, being however somewhat connected with the tendon of the gluteus by a small bursa mucosa.

Use.—This muscle is a rotator of the thigh outwards, at the same time slightly drawing the femur upwards; and when the thigh has been first flexed, it abducts it.

Immediately below the pyriformis, a small muscle is seen running parallel to it, which is termed

The *m. geminus superior*—which *arises* from the outer edge of the spinous process of the ischium, and from the anterior sacro sciatic ligament, takes a course directly outwards to be *inserted* into the fossa on the inner side of the trochanter major, between the insertions of the pyriformis, which is above it, and the obturator internus, which is below it.

In this posterior view of these muscles, the next which presents itself in the order of dissection is the tendon of the obturator internus; but to expose the fleshy origin of it, the subject must be turned round upon the back, when it will be found arising from the anterior and inferior parietes of the pelvis.

The *m. obturator internus*—*arises* by aponeurotic fibres from that portion of the pubes which forms the inner part of the circumference of the foramen obturatorium; it also arises from the obturator ligament, which fills up that foramen, as well from the ischium between the foramen and the ischiatic notch; from these origins the fleshy fibres converge towards the spinous process of the ischium; at which point they form a tendon, which passes out of the pelvis, lodged in a slight groove covered with cartilage, placed between the spinous process and tuberosity of the ischium, and consequently between the two sacro sciatic ligaments. The tendon may then be seen in the position in which it was first described when the subject was lying prone, passing to be *inserted* between the gemini muscles, with whose tendons it is connected, into the fossa on the inner side of the trochanter major.

Within the pelvis, this muscle is placed between the levator ani muscle, and obturator ligament; and as it leaves the pelvis passing through the lesser sciatic notch, its tendon is furnished with a bursa mucosa placed between it and the bone.

The *m. geminus inferior*—is placed below, but in conjunction with the tendon of the obturator internus; it *arises* from the back and outer part of the tuberosity of the ischium, and from the posterior sacro ischiatic ligament; its fibres pass outwards, and form a tendon, which may indeed be considered as common to the three last described muscles; and is *inserted* into the digital fossa, on the inner side of the trochanter major.

The gemini, and the tendon of the obturator internus muscles, are covered by the glutæus maximus, sciatic nerve, and vessels; they are placed between the pyriformis above them, and the quadratus femoris and obturator externus, which, in this view, is concealed by that muscle, below them.

Use.—These three muscles act together in rotating the thigh outwards; and by being connected with the capsular ligament of the hip-joint, serve to strengthen the articulation, and to prevent the ligament from being pressed between the bones during motion.

The *m. quadratus femoris*—is situated immediately below the geminus inferior, extending transversely between the ischium and trochanter; it *arises* from the outer side of the tuberosity of the ischium; its fibres are directed outwards to be *inserted* into a rough line passing from the lower and back part of the great trochanter to the trochanter minor; and which is termed, in consequence of its receiving the insertion of this muscle, the *linea quadrata.*

This muscle is covered posteriorly by the glutæus maximus, ischiatic nerve, and vessels; it covers the obturator externus; its origin is anterior to the origins of the semimembranosus, semitendinosus, and biceps; and its insertion partly covers the tendons of the psoas and iliacus, where they are inserted into the trochanter minor; above, it is bounded by the geminus inferior, and below, by the upper free edge of the adductor magnus, internal circumflex, and branches of the obturator artery.

Use.—To rotate the thigh outwards, and to adduct it.

The next muscle to be dissected, according to the classification I have adopted as to their function, is the obturator externus muscle, being one of the rotators outwards of the thigh; but in consequence of its deep situation, covered posteriorly by the quadratus femoris, anteriorly by the adductor longus, brevis, and pectinæus muscles, it may be more convenient not to examine the origin of it, until the adductor triceps femoris has been dissected and removed: however, it may be well to expose the posterior view of this muscle at this period of the dissection, by cutting through the quadratus femoris and reflecting it towards its attachments.

The subject is again to be turned upon the back, to dissect the adductor muscle of the hip-joint.

The *m. triceps adductor femoris*—is composed of three distinct origins, which pass from the pelvis to the femur.

The *m. adductor longus*—is the anterior of the three; it *arises* by a short strong tendon from the pubes, in a space between its spinous process and symphisis; it soon becomes fleshy, and passes downwards, backwards, and outwards, to be *inserted* by a narrow tendon into the linea aspera in the middle third of the femur.

The origin of this muscle is placed between the pectineus and gracilis, and anterior to the adductor brevis; its insertion is posterior to the vastus internus, separated from it by the fascia lata, and anterior to the adductor magnus; it has, where attached to the femur, above it, the insertion of the adductor brevis; below it, the adductor magnus: it is covered in front by the fascia lata, sartorius muscle, and femoral vessels.

The *m. adductor brevis*—*arises* tendinous and fleshy from the pubes, between the symphisis and obturator foramen; from thence it descends outwards and backwards to be *inserted* into the linea aspera, between the insertion of the pectineus and the adductor longus, occupying the upper third of the body of the femur.

It is covered anteriorly by the adductor longus, and pectineus; it lies upon the adductor magnus and obturator externus; internally it is bounded by the gracilis, and externally by the psoas and iliacus; its insertion is on a plane anterior to the pectineus, and adductor magnus.

The *m. adductor magnus*—is by far the largest, and most posterior muscle of the three; it *arises* fleshy from the whole length of the descending ramus of the pubes, and ascending ramus of the ischium; also tendinous from the tuberosity of that bone: from these origins the fibres pass outwards aud downwards, with various degrees of obliquity, those from the pubes most transversely to be *inserted* into the whole length of the linea aspera; and at the junction of the middle with the lower third of the femur, it sends off a rounded tendon to be inserted into the internal condyle.

The adductor magnus arises behind the other two adductors; its insertion is also behind these muscles, but anterior to the glutæus maximus and short head of the biceps, from which it is separated by the attachment of the fascia lata to the linea aspera between them. It is covered anteriorly by the gracilis, long and short adductors, pectinæus, sartorius and femoral vessels; which latter, at the inferior fourth of the thigh, penetrate a foramen composed of fascia, common to this muscle and the vastus internus, to gain the popliteal region. The upper edge of this muscle, as it passes from the tuberosity of the ischium to the femur, runs parallel to and below the quadratus femoris; the three heads of the adductors are perforated by the muscular branches of the profunda artery.

Use.—The triceps adductor femoris brings the one thigh forcibly towards the other, and tends to rotate it outwards; the two shorter heads assist in flexing the femur upon the pelvis, but the adductor magnus opposes them in this action.

The three origins of this muscle, and the pectinæus, being now separated from the pelvis, we expose the attachment of the sixth rotator outwards of the thigh.

The *m. obturator externus*—*arises* from that portion of the pubes and ischium which form the circumference of the obturator foramen, as well as from the obturator ligament:

the fibres converge from these origins, passing obliquely outwards and backwards towards a groove situated between the tuberosity of the ischium and the acetabulum; here they form a tendon, which winds around the neck of the femur, adhering to the capsular ligament, and is ultimately *inserted* into the lower part of the digital fossa, on the inner side of the trochanter major.

Anteriorly the origin of the obturator externus is covered by the triceps, pectinæus, and obturator vessels; posteriorly, it is attached to the obturator foramen, and ligament; its tendon is covered, anteriorly, by the hip-joint; posteriorly, by the quadratus femoris; and is bounded, above, by the geminus inferior muscle.

Use.—To rotate the thigh outwards; and when the glutæi abduct the lower extremity, to support the hip-joint, and to assist in again adducting the limb.

The fourteenth and last muscle of the hip-joint is—

The *m. tensor vaginæ femoris*—which is placed at the upper and outer part of the the thigh. It *arises* by a narrow tendinous origin from the outer part of the superior and anterior spinous process of the ilium; being narrow above, it becomes broader as it descends obliquely backwards, to be *inserted* into the fascia lata, about three inches below the trochanter major.

This muscle is concealed by the fascia lata of the thigh, being completely enclosed between two layers; the origin of the muscle is between the sartorius, which is anterior to it, and the glutæus medius, which is behind it; its insertion is anterior to the insertion of the glutæus maximus.

Use.—To stretch the fascia lata; and, if still in a state of action, to rotate the thigh inwards; it also assists in the abduction of the limb.

I have thus given the muscles belonging to the function of the hip-joint, in order that the student might connect their use and relation to each other; but some difficulty will arise in this progress of dissection, from the insertions of several of these muscles being concealed by some of those which belong to the knee-joint.

Nevertheless I consider the adoption of this plan preferable, in order that the muscles of different joints should not be confounded with each other.

The muscles of the knee-joint are ten in number; six flexors, and four extensors. The flexors are situated principally on the back part of the thigh; the extensors on the fore part: and they are more or less separated from each other by processes of the fascia lata.

Before these muscles can be traced to their insertions into the tibia and fibula, the fascia of the leg must be described.

This fascia is a continuation of the fascia lata of the thigh, commencing from its attachment to the bones of the leg; it is strengthened by fibres from the tendons of the extensors of the knee-joint in front, from the biceps externally, from the flexors and inner hamstring internally, and from the poplitæus posteriorly; it proceeds downwards towards the ancle, adhering firmly to the bones of the leg, and forms an aponeurotic covering, confining all the muscles on the anterior part of the leg; while, posteriorly, it separates them into a superficial and deep layer by a strong portion which dips between them; while external to the posterior muscles, it forms but a comparatively thin investment. At the upper part of the leg, this fascia is strongest, and becomes thinner as it descends, until it reaches the malleoli, where its strength again increases by the addition of some tendinous fibres, which form with it the annular ligament.

The deep posterior portion of this fascia cannot be seen until the extensors of the ancle-joint have been dissected.

The external fascia of the leg must be removed, to proceed with the dissection of the muscles of the knee-joint.

The four extensors of the knee-joint, are the rectus, cruræus, and two vasti.

The *m. rectus femoris—arises* by a strong tendon from the anterior and inferior spinous process of the ilium, and also from the dorsum of the bone, just at the edge of the acetabulum, being there connected with the capsular ligament of the hip-joint; from these two tendinous origins it forms a thick fleshy muscle, which passes vertically downwards to be *inserted* tendinous into the upper part of the patella, in common with the vasti; continuing downwards so as to form in part the ligamentum patellæ.

This is a double penniform muscle; its upper half, anteriorly, is covered with tendon, over which the sartorius glides; while its posterior surface, in the lower half, is also furnished with tendon, which facilitates its motion on the cruræus.

Its anterior surface is covered by the fascia lata, iliacus, and sartorius muscles; its posterior surface, above, covers the capsular ligament of the hip-joint, and the external circumflex vessels; in the rest of its extent it lies upon the cruræus and vasti muscles.

Use.—To extend the leg, and to assist in flexing the thigh upon the pelvis. In the erect posture, it fixes the pelvis and adds strength to the hip-joint.

The *m. cruræus*—*arises* from the fore and external part of the femur, commencing from a space between the two trochanters; it proceeds downwards, along three fourths of that bone; and on the outer side, extends as far backwards as the linea aspera: it then inclines forwards, becomes tendinous, posteriorly, where it is separated from the bone by a considerable quantity of adipose matter, and a large bursa; its tendon is *inserted* into the upper part of the patella, behind the rectus, in common with that muscle and the two vasti.

The anterior surface of the cruræus is covered by the rectus and two vasti, to which muscles it is firmly connected; superiorly, they are somewhat separated by some large vessels and nerves which pass between them.

Use.—To assist in extending the leg.

The *m. vastus externus*—is the largest of the three muscles which cover the anterior surface of the thigh-bone; it *arises* above, by a broad, tendinous and fleshy origin, from the root and outer surface of the trochanter major, anterior to the tendon of the glutæus maximus; from the whole length of the outer edge of the linea aspera, reaching as far as the external condyle, and from the flattened outer surface of the femur; from these origins it forms a strong fleshy belly, which is tendinous anteriorly above, and posteriorly below; from which tendons its fibres also arise, and pass obliquely downwards and forwards to be *inserted* into the outer edge of the tendon of the rectus and corresponding part of the patella, sending off an aponeurotic process, which passes over the outer side of the knee-joint to be inserted into the tibia.

It is covered by the fascia lata, and partly by the rectus; it overlaps the outer edge of the cruræus; its origin from the linea aspera is anterior to the insertion of the glutæus maximus, and the origin of the short head of the biceps, being separated from them by a process of fascia lata.

Use.—To extend the knee, and assist in the rotation of the limb outwards.

The *m. vastus internus*—begins to *arise* from the fore part of the os femoris, immediately below the trochanter minor; from the anterior edge of the whole length of the linea aspera, and from the inner surface of the femur; this muscle, like the preceding, is tendinous anteriorly above, and posteriorly below, where its fleshy fibres descend lower than those of the vastus externus, and pass obliquely downwards and forwards, to be *inserted* into the inner edge of the tendon of the rectus and side of the patella; sending off an aponeurosis, which covers the inner side of the knee-joint, and terminates in the fascia of the leg.

At the root of the trochanter minor its origin is anterior to the insertion of the iliacus and psoas, along the linea aspera; it is anterior to the pectinæus, and triceps adductor femoris; it partly overlaps the cruræus, and is covered by the fascia lata, which separates it from the posterior muscles of the thigh; inferiorly, it is crossed by the sartorius.

Use.—To extend the leg, and slightly rotate it inwards.

The flexors of the knee-joint are, the sartorius, gracilis, semitendinosus, semimembranosus, biceps, and poplitæus.

The *m. sartorius*—is the longest muscle in the body, and crosses the thigh from without inwards in a serpentine direction ; it *arises* by short aponeurotic fibres from the anterior and superior spinous process of the ilium, soon becomes fleshy, and passes obliquely downwards and inwards along the upper third of the thigh ; it is then directed vertically towards the back part of the inner condyle, where it again alters its course by passing forwards and outwards to be *inserted* by a flat tendon into the inner side of the tibia, immediately below its tubercle ; this tendon also expands into an aponeurosis, which is connected with the fascia of the leg.

The sartorius, anteriorly, is covered by the fascia lata ; it arises between the tensor vaginæ femoris and iliacus ; in its passage downwards to its insertion, it successively covers the psoas, iliacus, rectus, cruræus, and vasti muscles ; then reaching the triceps adductor femoris, runs for some way parallel with, and between it and the gracilis ; in the middle of the thigh it crosses the femoral vessels ; and lastly, the internal lateral ligament of the knee-joint. In its upper third its internal edge forms the outer boundary of a triangular space between it and the adductor longus, in which the femoral vessels and nerve are placed. It is this space wherein the femoral artery is usually secured in cases of popliteal aneurism ; and the sartorius muscle is the guide for the incision which exposes its sheath.

Use.—To flex the leg upon the thigh, and direct it across the opposite extremity ; if still kept in action, it assists the flexion of the thigh upon the pelvis ; it slightly rotates the leg outwards.

The *m. gracilis*—*arises* from the anterior surface of the body of the pubes, from the descending ramus of that bone, and the ascending ramus of the ischium ; from these origins it passes vertically downwards on the inner side of the thigh, becoming narrower as it descends ; and at about the junction of the middle with the lower third of the thigh, forms a round tendon, which passes behind the internal condyle, and is *inserted* into the inner and upper part of the tibia, below and behind the insertion of the sartorius; also sending an aponeurotic expansion to the fascia of the leg.

At its origin, it is placed on the inner side of the triceps femoris, between it and the crus penis; its inner surface is covered by the fascia lata, and below by the sartorius; it covers the adductor magnus, semimembranosus, and the internal lateral ligament of the knee-joint; it is inserted between the sartorius, which is above it, and the semitendinosus, which is below it.

Use.—To flex the leg, and also to adduct it.

The four remaining flexors of the knee are situated on the posterior part of the thigh.

The *m. semitendinosus*—*arises* tendinous and fleshy from the tuberosity of the ischium, in common with the long head of the biceps, and fleshy from the inner side of the tendon of the biceps; from these origins the fibres pass obliquely downwards and inwards, forming a fleshy muscle, which terminates in a round tendon about four inches above the knee; this tendon passes behind the internal condyle placed between the inner origin of the gastrocnemius, and tendon of the semimembranosus; is *inserted* into the inner side of the tibia, below the insertion of the gracilis muscle, to which it is connected by an aponeurotic expansion, as well as to the fascia of the leg.

The origin of the semitendinosus is covered by the glutæus maximus; it lies between the biceps and gracilis; posteriorly it is covered by the fascia lata, anteriorly it crosses the upper part of the adductor magnus.

This muscle is usually intersected about its middle by a transverse tendinous line; from which circumstance it has been probably named; for, in fact, it is not so tendinous a muscle as the semimembranosus.

Use.—To flex the leg, and to turn it slightly inwards.

The *m. semimembranosus.*—Its origin is concealed by the common origin of the preceding muscle, and of the long head of the biceps; it *arises* by a flat tendon from the upper and fore part of the tuberosity of the ischium; the tendon becomes broader as it descends, before the fleshy fibres commence, then forms a thick belly, which passes with very slight obliquity downwards, and terminates in another flat tendon, which is directed vertically to be *inserted* into the upper, inner, and back of the head of the tibia; the outer edge of this tendon sends off an aponeurotic expansion, which passing anterior to the inner head of the gastrocnemius, assists in forming the posterior ligament of Winslow, which is affixed to the external condyle of the femur.

This muscle lies between the biceps on its outer side, and the semitendinosus on its inner; it is bounded, anteriorly, by the adductor magnus, and posteriorly, it is covered by the fascia lata; it forms the inner boundary of the popliteal space.

Use.—To flex the leg; and it also, from its connection with the semilunar cartilages, through the medium of the posterior ligament of Winslow, performs the important office of fixing them in their relative situation during the motions of the knee-joint.

The *m. biceps flexor cruris*—*arises* by a long and a short head: the long head, by a tendon from the upper and outer part of the tuberosity of the ischium, in common with the semitendinosus; it proceeds downwards and outwards, diverging from the semitendinosus, forms a thick fleshy belly which, below the middle of the thigh, unites with the short head: the short head arises by aponeurotic fibres from the linea aspera, immediately below the insertion of the glutæus maximus to within two inches of the outer condyle; here the fibres of the two heads unite at an acute angle, and terminate in a strong tendon, which passes behind the external condyle; and then, being directed forwards, and outwards, is *inserted* into the upper, outer, and back part of the head of the fibula, sending off an aponeurosis to be connected with the posterior ligament of the knee-joint.

The origin of the long head is covered by the glutæus maximus, is connected with the semitendinosus, and covers the origin of the semimembranosus; in passing downwards to be connected with the short head, its anterior surface covers the semimembranosus, vastus externus, and adductor magnus; its posterior surface is covered by the fascia lata. As it diverges from the semimembranosus, it forms the outer boundary of a triangular space, within which is placed the great sciatic nerve. The tendon of this muscle, inferiorly, forms the outer boundary of the popliteal space, or outer hamstring.

Use.—To flex the leg, and, when flexed, to rotate the leg outwards; its long head also extends the thigh upon the pelvis.

The *m. poplitæus*—is next in order to be dissected; but some difficulty arises in exposing it, from its lying under the origins of the external head of the gastrocnemius, and plantaris muscles. It *arises* by a thick and strong tendon from a sulcus situated on the back part of the external condyle of the femur, beneath the attachment of the external lateral ligament of the knee-joint; this tendon passes obliquely downwards and inwards, being attached to the posterior ligament of Winslow, and the external semilunar cartilage; the muscle then becomes broad and fleshy, to be *inserted* into a triangular space occupying the superior fifth of the posterior surface of the tibia,

The posterior surface of this muscle is covered by the gastrocnemius, plantaris, popliteal vessels, and posterior tibial nerve; its anterior surface is in contact with the posterior ligament of Winslow, external semilunar cartilage, tibialis posticus muscle, and the triangular space on the upper part of the tibia.

Use.—To flex the knee, and confine the external semilunar cartilage in its situation, and to rotate the tibia and foot inwards.

We next proceed to the dissection of the muscles of the ancle-joint, which are six in number; namely, the gastrocnemius, plantaris, solæus, tibialis posticus, peroneus longus and brevis tibialis anticus, and the peroneus tertius: which last is usually described as a portion of the extensor longus digitorum.

From the intimate connection of these muscles with those of the toes, and from their situation being in common, the same difficulty occurs which we had to contend with, in the dissection of the muscles of the fore arm.

Instead, therefore, of following their dissection strictly according to their function, we shall describe them in the following order, which is consistent with their natural situation; namely, those which are *posterior* to the tibia and fibula, those which are *anterior*, and those situated on the *outer* side.

The posterior muscles are six in number, which are divided into a superficial and deep-seated layer; the superficial layer consists of three muscles belonging to the ancle-joint; the deep-seated layer is also composed of three muscles, of which, one belongs to the ancle-joint, one common to the toes, and one proper to the great toe.

The anterior muscles are three in number; one of which belongs to the ancle-joint, one common to the toes, and one proper to the great toe; in this region also is found the peroneus tertius, which, when described separately, is also a muscle of the ancle-joint.

The external muscles are two in number; both of them belonging to the ancle-joint.

The superficial layer of the posterior muscles, consist of the gastrocnemius, plantaris, and solæus; which, being inserted by a common tendon, are, by some anatomists, termed the triceps extensor pedis.

The *m. gastrocnemius—arises* by two distinct tendinous origins; one from each condyle of the femur, the inner one being larger, and descending lower than the outer; they converge as they pass downwards, and soon unite, where they form a common aponeurosis, from which the fleshy fibres of the muscle arise, and form a strong fleshy belly, which terminates a little below the middle of the tibia in a broad flat tendon, which is common to it and the solæus, and is termed the tendo Achillis; *inserted* into the back part of the tuberosity of the os calcis; sliding over the upper half, where it is furnished with a bursa mucosa, and being firmly implanted into the lower half.

The external origin of this muscle is covered by the poplitæus; the internal origin, by the semimembranosus; the triangular intervening space lodges the poplitæal vessels; the posterior tibial nerve, and the plantaris muscle; the anterior surface of each head is furnished with a small bursa between them and the condyles of the femur. The belly of the muscle is superficial, forms a large portion of the calf of the leg, and its anterior surface, which is most aponeurotic, rests on the solæus muscle.

Use.—To extend the ancle-joint, by raising the heel and throwing the weight of the body upon the toes; its two heads strengthen the articulation of the knee-joint, by preventing the condyles of the femur slipping backwards off the tibia.

The *m. plantaris*—is the third muscle that is attached to the external condyle of the femur; from the upper part of which it *arises*, also from the posterior ligament of Winslow, and from the tendinous origin of the outer head of the gastrocnemius; from these origins it soon forms a short fleshy belly of about three inches in length, which descends obliquely inwards, to terminate in a long, thin tendon, just below the union of the two heads of the gastrocnemius; this tendon passes downwards between the gastrocnemius and soleus, and at the lower third of the leg passes out from between them, parallel and adhering to the inner side of the tendo Achillis, with which it is *inserted* into the tuberosity of the os calcis.

This muscle is covered by the gastrocnemius and fascia of the leg; anteriorly, it lies upon the external condyle of the femur, the posterior ligament of Winslow, the poplitæal vessels, and the poplitæus and soleus muscles.

Use.—It assists in extending the ancle-joint; it is not, however, to be found in all subjects.

The *m. soleus*, or *gastrocnemius internus*—*arises* by aponeurotic fibres from the posterior part of the head of the fibula, from the outer angle of that bone, and from two thirds of its length downwards, being in this situation placed immediately behind the peroneus longus. The second head arises from the oblique line, on the posterior surface of the tibia, which is seen immediately below the insertion of the popliteus muscle, and from the middle third of the inner edge of that bone; from these origins the fleshy fibres pass downwards, converging as they descend, and uniting, form a large belly, which extends nearly to the ancle-joint, is *inserted* by uniting with the tendon of the gastrocnemius to form the tendo Achillis.

The posterior surface of the soleus is covered by the gastrocnemius, plantaris, and fascia of the leg; its anterior surface is also covered by a fascia, which separates the three superficial from the deep muscles of this region.

Between the two origins of this muscle, are placed the posterior tibial artery and nerve.

Use.—The same as the two preceding muscles, forming together the tendon Achillis, which is broader above than below, and is separated to a considerable distance from the tibia and fibula, in consequence of the projection backwards of the tuberosity of the calcis.

These muscles should now be cut through, and reflected towards their attachments, when the fascia which separates them from the deep layer will be exposed.

The knowledge of the precise situation of this fascia is of importance, as it forms the readiest guide in the operation for securing the posterior tibial, and fibular arteries.

The deep-seated layer of muscles in the posterior region of the leg, and which are anterior to the above-named fascia, are the tibialis posticus, flexor longus digitorum, and flexor longus pollicis.

The *m. tibialis posticus*—*arises* by a broad fleshy origin, disposed in two distinct bundles of fibres; one from the outer and back part of the fibula: the other, which is the larger of the two, from the oblique line on the back part of the tibia, the anterior tibial vessels passing between the bifurcation; it also arises fleshy from the whole length of the interosseous ligament, occupying the greater part of its breadth above, and the centre part below, and from the angles of the tibia and fibula, to which the interosseous ligament is attached; from these several attachments the fibres descend obliquely downwards, and terminate in a strong round tendon which passes behind the malleolus internus, through a groove formed for it in the tibia, proceeding obliquely forwards and inwards in the sole of the foot, to be *inserted* principally into the upper and inner part of the os naviculare, sending tendinous fibres, which are at tached to the internal, and external cuneiform bones, to the cuboid, to the os calcis, as well as to the second and third metacarpal bones.

The tendon of this muscle, as it passes beneath the astragalus, is furnished with a bursa mucosa, and sometimes with a sesamoid bone.

The origin of this muscle has some few fibres passing through the upper interosseal opening, and is therefore described by some anatomists as arising from the anterior part of the tibia and fibula. The rest of its anterior surface covers portions of the tibia, fibula, interosseous ligament, and some of the tarsal ligaments. The posterior surface of the tibialis postieus is covered by the fascia separating the superficial, from the deep seated muscles, and by the flexor longus digitorum, and flexor pollicis; the two latter of which, although they partly cover this muscle, I have not deemed it necessary to separate them in my classification of the muscles belonging to the functions of the ancle-joint. The tendon of this muscle, when it has reached the sole of the foot, passes under, and supports a strong ligament, which extends from the os calcis to the os naviculare, underneath the astragalus; and is principally concerned in maintaining, or receiving the weight of the body, when jumping from an eminence.

Use.—To extend the ancle-joint, and to direct the inner edge of the foot upwards.

The *m. flexor longus communis digitorum pedis*—*arises* from the posterior flattened surface of the tibia, commencing immediately below the origin of the soleus muscle, and extending three fourths down the bone, from the interosseous ligament, and from the anterior surface of the deep fascia of the leg; the fleshy fibres from these origins descend obliquely inwards, being thickest in their middle part, and terminate in a tendon which commences at the internal and posterior part of the muscle. The tendon then passes behind the malleous internus in the same groove with, but below, the tibialis posticus, and passing on the inner sinuosity of the os calcis, reaches the sole of the foot, in the middle of which it divides into four tendons: these diverge, proceed forwards to the bases of the first phalanges, where they enter tendinous the thecæ, and passing through the split tendons of the flexor brevis digitorum at the extremities of the first phalanges, are *inserted* into the extreme phalanges of the four lesser toes.

The anterior surface of this muscle lies upon the tibia, and interosseous ligament; above, to the inner side of the tibialis posticus, which it partly covers; and below, on the inner side of the flexor longus pollicis; it is covered behind by the posterior tibial artery, and deep fascia of the leg.

Use.—To flex the third upon the second phalanx; but if still in action, to bend the other phalanges of the toes, and the toes themselves upon the metatarsus, and ultimately to assist in the extension of the foot.

The *m. flexor longus pollicis pedis—arises* fleshy from a flat surface on the posterior part of the fibula, commencing immediately below the attachments of the soleus, and reaching to within an inch of the inferior extremity of the bone; its fibres pass obliquely downwards and inwards, and terminate in a tendon which takes its course behind the inner malleolus, through a groove which is formed first in the tibia, and then continued in the astragalus, where it is posterior to the tendon of the last described muscle; reaches the sole of the foot where it passes above the tendon of the flexor digitorum, and is connected with it by a slip of tendon; it then proceeds between the two origins of the flexor brevis pollicis, between the two sesamoid bones; and penetrating the fibrous theca, is ultimately *inserted* into the under and posterior surface of the last phalanx of the great toe.

The posterior surface of this muscle is covered by the deep fascia of the leg; the anterior surface lies upon the fibula and tibialis posticus; it lies between the peroneus longus on its outer side, and the tibialis anticus on its inner: its tendon is furnished with synovial membranes behind the inner malleolus, and on the great toe; in the space between the two, its tendon is enveloped by the two heads of the flexor brevis pollicis.

Use.—To bend the second upon the first phalanx, and the toe upon the metacarpal bone; it also extends the foot, and increases its longitudinal arch.

We next proceed to the muscles situated between the tibia and fibula in front, which consist of the tibialis anticus, extensor longus digitorum, and extensor longus pollicis muscles; which receive a covering from the fascia of the leg.

The *m. tibialis anticus*—*arises* fleshy from the outer and fore part of the tibia, immediately below its head, and also from the head of the fibula; in the intermediate space, between the two, its fibres are connected with the tibialis posticus, through the interosseous opening. Its origin extends two thirds down the anterior angle, or spine of the tibia, and inner half of the interosseous ligament, as well as from the posterior surface of the fascia of the leg; its fibres descend obliquely outwards, and terminate in a strong flat tendon, which passes from the outer to the anterior surface of the tibia, runs underneath the annular ligament, and gains the dorsum of the foot; here the tendon becomes broader, passes on the inner side of the tendons of the extensor longus digitorum, to be *inserted* into the upper and inner part of the os cuneiforme internum, and root of the metatarsal bone supporting the great toe.

This muscle is superficially situated; at its origin it is placed on the outer side of the tibia, but lower down becomes anterior to it; it has before it the fascia of the leg, behind it the tibia, head of the fibula, and interosseous ligament; it has on its outer side, above, the extensor digitorum, and below, the extensor longus pollicis,—a space being left between it and these muscles, in which the anterior tibial vessels and nerves pass. Between the tendon of the tibialis anticus and internal cuneiform bone, a small bursa is situated.

Use.—To flex the ancle-joint, and direct the foot inwards.

The *m. extensor longus digitorum pedis*—*arises* tendinous and fleshy from the outer surface of the head of the tibia, from the inner side of the head of the fibula, and from about three fourths of its anterior angle ; in part also from the interosseous ligament, and fascia of the leg. Its fibres pass with more or less obliquity inwards, and in the lower third of the leg terminate in a tendon, which commences in the substance of the muscle ; this tendon, before it passes under the annular ligament, splits into three; and as they gain the dorsum of the foot, the inner tendon bifurcates: the four tendons then diverge, and pass to be *inserted* into all the phalanges of the four lesser toes, covering their dorsal surface as an expanded aponeurosis.

There is a slip of muscle arising from the fibula in common with the extensor longus digitorum, which is by some anatomists described as a separate muscle, under the name of

The *m. peroneus tertius* :—which *arises* generally inseparably with the extensor digitorum communis, from the lower third of the fore part of the fibula and interosseous ligament; from thence it descends with the last described muscle under the annular ligament; inclosed in the same groove, and gaining the dorsum of the foot, diverges from it to be *inserted* into the base of the metatarsal bone supporting the little toe.

This muscle (or the two, if considered separately) is superficial, covered by the fascia of the leg. At the upper part of the leg, it is placed between the tibialis anticus, and peroneus longus, being firmly connected with them by intermuscular ligament; at the lower part it is placed between the extensor longus pollicis, and peroneus brevis; its posterior surface is in contact with the fibula, and interosseous ligament.

Use.—To extend the phalanges of the lesser toes; but that portion of the muscle which is termed the peroneus tertius, being inserted into the metatarsus, is a flexor of the ancle-joint; in which function the common extensor of the toes can assist.

The *m. extensor proprius pollicis pedis*—*arises* tendinous and fleshy from the fore part of the two inferior thirds of the fibula, between its anterior and internal angles, within an inch of the ancle-joint; also from the lower part of the interosseous ligament, and some few fibres from the edge of the inferior extremity of the tibia; from these origins, the fibres pass obliquely forwards and downwards, terminating in a tendon, which passes under the annular ligament, runs along the inner side of the foot, and passes to be *inserted* by separate tendons into the two phalanges of the great toe.

This muscle is situated between the tibialis anticus and extensor digitorum communis, and is concealed by them at its origin and middle portion; its tendon then becomes superficial, being covered only by the fascia of the leg. The anterior tibial vessels and nerve lie between this muscle and the tibialis anticus, above the annular ligament; but below, between it and the inner tendon of the extensor digitorum communis.

Use.—To extend the phalanges of the great toe, and to assist in the flexion of the ancle-joint.

The muscles situated on the outer side of the leg, are the peroneus longus and brevis.

The *m. peroneus longus*—*arises* tendinous and fleshy from the outer and fore part of the head of the fibula, and outer side of the head of the tibia; from the external angle of the fibula, two thirds down its length, from the anterior surface of that bone, from the posterior surface of the fascia of the leg, and from the intermuscular tendon, which is anteriorly, common to this muscle and the extensor longus digitorum, posteriorly, in common to it and the flexor digitorum communis. From these origins the fibres descend with slight obliquity outwards, and at the lower part of the leg terminate in a tendon, which passes through a groove on the inner side of the malleolus externus; then runs forward on the outer side of the os calcis; and reaching the os cuboides, continues through a deep groove in it which directs it inwards, above the muscles in the sole of the foot, to reach its *insertion* into the outer side of the base of the metatarsal bone of the great toe, and the os cuneiforme internum.

It is better to leave the dissection of the insertion of this muscle, until the muscles situated on the sole of the foot have been examined.

This muscle is superficially placed on the outer side of the fibula, being bounded anteriorly by the extensor longus digitorum, and posteriorly by the soleus and flexor longus pollicis; its tendinous insertion is covered by the muscles of the sole of the foot.

Use.—To extend the ancle-joint, and to direct the outer edge of the foot upwards; in which action it is opposed by the tibialis posticus.

The *m. peroneus brevis*—*arises* by short aponeuroses from the outer and posterior surface of the lower half of the fibula, and from the intermuscular tendons which connect it anteriorly with the extensor longus digitorum, and posteriorly with the flexor longus pollicis; its fibres descend a little obliquely outwards, and at the lower part of the leg form a tendon, which passes behind the malleolus externus with the peroneus longus, then through a groove on the outer side of the calcis, above the tendon of the preceding muscle; it reaches the base of the metatarsal bone, supporting the little toe, into which it is *inserted.*

The outer surface of this muscle is covered by the peroneus longus; it proceeds downwards, between the extensor longus digitorum, which is before it, and the flexor longus pollicis, behind it; at the malleolus externus, the tendon of this muscle is below that of the peroneus longus, but when it gains the os calcis, the tendon of the peroneus brevis is above and anterior to it.

Use.—To extend the ancle-joint as the preceding muscle.

The tendons of the preceding muscles, as they pass through the grooves behind the malleoli, are tied down by strong tendinous sheaths, lubricated with synovia; the annular ligament, in a like manner, and for a similar purpose, proceeds from one malleolus across to the other, in front of the inferior extremities of the tibia and fibula; being connected to the projections on the surface of the bones.

All the muscles proper to the toes, and some of those common to them, are attached entirely to the bones of the foot, and are by most anatomists classified as the proper muscles of the foot; whereas those of the ancle-joint, which move the foot, are, properly speaking, to be considered as belonging to that division of the lower extremity.

Before these muscles can be dissected, the skin and fascia plantaris must be removed. Of the skin, it may be observed, that it is here thicker than in any other part of the body, in consequence of the constant pressure to which it is exposed; underneath it there is always found a considerable quantity of fat, which furnishes a soft cushion, and prevents the ill effects which would otherwise arise from the concussion and bruising to which the soft parts underneath are liable.

On removing the skin, (which is a task of some difficulty, from the firm manner in which it adheres to the subjacent aponeurosis, by fibres of short and dense cellular membrane),

The *fascia plantaris*—is exposed; it *arises* from the anterior part of the under surface of the tuberosity of the os calcis, and appears as if it were a continuation of the tendo Achillis, commencing by a thick narrow strip, which proceeds forwards along the under surface of the foot, becoming broader and thinner as it approaches the toes, and terminates, being attached by distinct portions to the anterior extremities of the metatarsal bones; each portion splitting at its insertion to allow of the passage of the flexor tendons of the toes.

Besides the division of this fascia, in the anterior part of the sole of the foot at its insertion into the metatarsus, it also separates itself, in the middle of the plantar region, into three portions: the centre one, which is the thickest, covers the flexor muscles common to the toes; while the lateral more attenuated portions, cover the muscles forming the ball of the great and little toe.

This fascia being removed, the muscles situated above it are to be dissected; the description of which may be much facilitated by arranging them in four layers.

The first layer is composed of the flexor brevis digitorum pedis, in the middle; the abductor pollicis pedis, on the inner; and the abductor minimi digiti pedis, on the outer side.

The *m. flexor brevis digitorum pedis perforatus* — is a muscle common to the toes; it *arises* from the inferior surface, and rather to the inner side of the tuberosity of the calcis, from the upper surface of the fascia plantaris, and the intermuscular tendons, separating this from the abductor pollicis on the inner side, and the abductor minimi digiti on the outer; from these origins, the muscle passes forwards to the middle of the foot, where it divides, sending off four slender tendons, which diverge as they pass to the second phalanges of the four lesser toes, where they split to allow of the transmission of the tendons of the flexor longus digitorum; and are then *inserted* into the anterior extremities of the second phalanges by tendinous expansion.

The under surface of this muscle rests upon the fascia plantaris; the upper surface is covered by the tendons of the flexor longus digitorum, musculus accessorius, and lumbricales; its inner edge is bounded by the abductor pollicis, with which it is connected posteriorly; while, anteriorly, it is separated from it by the tendon of the flexor longus pollicis; its outer edge is bounded by the abductor minimi digiti. The short flexor tendon from this muscle to the little toe, is not unfrequently wanting.

Use.—To flex the second phalanges of the four toes, and to strengthen the arch of the foot, in conjunction with the long flexor of the toes and plantar fascia.

The *m. abductor pollicis pedis.*—This muscle is proper to the great toe, and forms the inner boundary of the inner region of the foot; it *arises* tendinous and fleshy from the inner side of the under surface of the tuberosity of the os calcis, from a ligament which extends from the calcis along the os naviculare to the internal cuneiform bone, and from the fascia plantaris; the fleshy fibres from these origins pass forward parallel to the metatarsal bone supporting the great toe, and are *inserted* tendinous into the inner sesamoid bone, and root of the first phalanx.

The under surface of this muscle rests upon the inner portion of the plantar fascia; its upper surface is partly covered by the flexor brevis pollicis, and the tarsal bones.

Use.—To abduct the great toe.

The *m. abductor minimi digiti pedis*—is proper to the little toe; it *arises* tendinous and fleshy from the outer side and under surface of the calcis, from the fascia plantaris, and from the outer surface of a ligament reaching from the os calcis to the base of the metatarsal bone supporting the little toe; its fibres pass forwards to be *inserted* tendinous into the anterior extremity of the metatarsal bone, and outer side of the base of the first phalanx of the little toe.

This muscle is the most external of this region; its under surface rests upon the outer portion of the fascia plantaris; its outer edge is merely covered by skin; its inner surface is in contact with the bones of the tarsus.

Use.—To abduct, and assist in flexing the little toe.

The second layer of muscles of the sole of the foot consist of the musculus accessorius, and lumbricales, and the tendons of the flexor longus digitorum, and flexor longus pollicis; which tendons have already been described when speaking of those muscles situated in the deep-seated region of the leg.

The *m. accessorius ad flexores digitorum pedis.*—This muscle *arises* fleshy from the sinuosity on the inner surface of the os calcis, and tendinous from the under part of the bone below the sinuosity; its fleshy fibres pass forwards, assuming a flattened square form; after which it converges, and terminates by being *inserted* into the outer part of the tendon of the flexor longus digitorum, just before that tendon divides.

This muscle arises from bone, and is inserted into tendon; its upper surface is covered by the os calcis, tarsal ligaments, and the origin of the abductor minimi digiti; its inferior surface covers the adductor pollicis, flexor brevis digitorum, abductor minimi digiti, and plantar vessels and nerves.

Use.—To assist the flexor longus digitorum in its action.

The *m. lumbricales pedis*—*arises* by four aponeurotic and fleshy origins from the tendons of the flexor longus digitorum, immediately after their division, and pass forward parallel to the inner edge of the long flexor tendons, to be *inserted* into the inner and under surface of the first phalanx of the four lesser toes, and into the tendinous expansion from the tendon of the common extensors, on their dorsal surface.

The lumbricales rest upon the flexor brevis digitorum; their upper surfaces are covered by the transversus pedis, and adductor pollicis.

Use.—To flex the first phalanx of the four lesser toes, and to adduct them, but to extend the second and third phalanges.

These muscles should be cut through, and reflected towards their attachments, to expose the third layer, which consists of the flexor pollicis brevis, adductor pollicis, transversus pedis, and flexor minimi digiti.

The *m. flexor brevis pollicis*—*arises* by a strong tendon from the lower and anterior part of the os calcis, also from the cuboid and under surface of the external cuboid bone. It soon forms a fleshy belly, which is directed forwards and obliquely inwards, becomes then connected with the adductor pollicis, and passes to be *inserted* by two tendons into the sesamoid bones, and root of the first phalanx of the great toe. Its inferior surface rests upon the tendon of the flexor longus, and adductor pollicis; its upper surface has above, the tendon of the peroneus longus, transversus pedis, and metatarsal bone of the great toe.

Use.—To flex the first phalanx of the great toe upon the metatarsus.

The *m. adductor pollicis*—*arises* tendinous and fleshy from the under and inner surface of the cuboid bone, and from the ligament which connects this bone with the os calcis; it also arises from the bases of the second, third, and fourth metatarsal bones; forms a triangular fleshy belly, the fibres of which converge towards the inner side of the foot, to be *inserted* by a double tendon into the outer sesamoid bone, and base of the first phalanx of the great toe.

The inferior surface covers the tendons of the flexor longus digitorum, lumbricales, and part of the accessorius; its upper surface is in contact with the bones from which it arises; its inner edge corresponds to the flexor brevis pollicis and insertion of the peroneus longus.

Use.—To adduct and assist in flexing the great toe.

The *m. transversus pedis*—*arises* tendinous and fleshy from the under surface and anterior extremity of the metatarsal bone of the little toe; passes inwards, crossing beneath the heads of all the metatarsal bones; and is *inserted* into the outer sesamoid bone, and into the root of the metatarsal bone of the great toe.

The under surface of this long strip of muscle covers the long flexor tendons, lumbricales, and digital branches of the arteries and nerves; the upper surface corresponds to the plantar, interossei, and metatarsal bones; at its insertion, its tendon is connected with the adductor pollicis.

Use.—To maintain the transverse arch of the foot, by drawing the anterior extremities of the metatarsal bones nearer to each other.

The *m. flexor brevis minimi digiti pedis*—*arises* tendinous and fleshy from the under surface of the os cuboides, from the tendinous sheath which lines the sulcus, in which the tendon of the peroneus longus passes, and from the base of the metatarsal bone of the little toe; from these origins, it forms a fleshy belly, which passes forwards to be *inserted* by tendinous fibres into the lower and outer edge of the base of the first phalanx of the little toe.

The inferior surface rests upon the abductor minimi digiti; its upper surface is covered by the metatarsal bone of the little toe, and the outer plantar interosseous muscle.

Use.—To flex the first phalanx of the little toe.

These muscles being removed, the muscles of the fourth layer are exposed, consisting of the interossei, and the insertion of the tendon of the peroneus longus.

The *m. interossei pedis*—are disposed in a similar manner to those of the hand, being extensors to the toes, and are arranged—four upon the dorsum, and three upon the plantar region of the foot; the three latter of which we have now to describe.

The *m. interossei plantaris*, or *inferiores*—are three in number, and are situated in the spaces between the metatarsal bones.

The first of these, beginning on the inner side, is

The *m. adductor medii, vel tertii digiti*—*arises* from the inner side of the metatarsal bone of the middle, and from the outer side of the root of the metatarsal bone of the second toe; it then forms a fleshy belly, which fills up the space between the two bones, and is *inserted* into the inner side of the base of the first phalanx of the third or middle toe.

The anterior tibial artery passes through the fibres of this muscle to gain the plantar region of the foot.

Use.—To adduct the third or middle toe.

The *m. adductor quarti digiti*—*arises* from the inner side of the metatarsal bone of the fourth toe, and also from the root of the third, and passes forwards to be *inserted* into the inner side of the base of the first phalanx of the fourth toe.

The use of this muscle is implied by its name.

The *m. adductor minimi digiti*—*arises* from the inner side of the metatarsal bone of the little toe, and base of the fourth; and passes to be *inserted* into the inner side of the root of the first phalanx of the fifth toe.

In a like manner to the two preceding, this muscle adducts the toe to which it is inserted.

The tendon of the peroneus longus, which can only be traced to its insertion in this stage of the dissection, has been already described.

We next proceed, in the order of dissection, to the muscles situated on the dorsum of the foot; these are, the interossei externi, and the flexor brevis digitorum.

The *m. interossei externi, vel superiores*—are four in number, are larger than the internal, arise by two heads, and are sometimes called the interossei bicipites.

The *m. adductor digiti secundi*—*arises* from the inner side of the metatarsal bone of the second, and from the outer side of the metatarsal bone of the great toe—the two origins being separated to admit the passage of the anterior tibial artery; the belly of this muscle passes forward to be *inserted* into the inner side of the root of the first phalanx of the second toe.

Use.—To draw the second towards the great toe.

The *m. abductor digiti secundi*—*arises* chiefly from the outer side of the metatarsal bone of the second toe, and inner side of the third toe; and passes to be *inserted* into the outer side of the first phalanx of the second toe.

Use.—To draw the second from the great toe.

The *m. abductor digiti medii*—*arises* chiefly from the outer side of the metatarsal bone of the middle or third toe, and outer side of the fourth; and is *inserted* into the outer side of the base of the first phalanx of the middle or third toe.

Use.—To draw the third toe outwards from the second.

The *m. abductor digiti quarti*—*arises* from the outer side of the fourth, and inner of the fifth metatarsal bone; and is *inserted* into the outer side of the root of the first phalanx of the fourth toe.

Use.—To separate the fourth from the three inner toes.

These muscles, collectively, strengthen the arch of the foot in a transverse direction, by drawing the metatarsal bones closer together; and although, separately, they serve to abduct and adduct the toes, yet, collectively, they assist in their extension.

The *m. extensor brevis digitorum*—*arises* tendinous and fleshy from the upper and anterior surface of the os calcis, from the astragalus, annular ligament, and os cuboides; from these origins, its fibres form a flat fleshy belly, which separates at its anterior part, and terminates in four slender tendons to be *inserted* into the four inner toes; the innermost tendon, which is the strongest, into the first phalanx of the great toe; while the tendons in common with the extensor longus digitorum, unite to form the aponeurotic expansion which covers the dorsal surface of the three middle toes.

The fleshy fibres of this muscle lie under the tendons of the extensor longus digitorum, and peroneus tertius, but are not concealed by them; the inferior surface lies on the tarsus, metatarsus, interossei superiores, and the phalanges. The flat and slender tendons of this muscle, although they lie above the superior interossei, do not so cover them as to prevent their dissection in the order in which they have been described.

LECTURE XIX.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Lower Extremities.

The combined actions of the muscles of the lower extremities, being highly important as the principal agents of locomotion, I shall now proceed to mention several particulars respecting them.

The lower extremities present a remarkable difference from the upper, in being destined to support the great weight of the body, at the same time they have to perform their several motions. The perfection of this combined function, in the structure of the joints of the lower extremities, and which so admirably contributes to the erect position in man; is a principal feature, which renders him superior to all other animals.

The erect posture is maintained by the muscles of the head being inserted into the bones of the spine; the muscles of the spine, receiving their fixed point from the bones of the pelvis; the muscles of the pelvis, from the femora and upper part of the bones of the leg; the muscles of the thigh, from the leg and foot; and the muscles of the leg, from the foot: thus the erect position of the body is the result of the united action of the muscles of these several regions.

Standing in the erect posture on both legs, the centre of gravity will fall in an imaginary perpendicular line between the two; but if the pressure be not equal on both legs, the centre of gravity will fall to that side on which the pressure is greatest, and a degree of obliquity is given to the position of the body. It is necessary to remember, that this change of the centre of gravity constantly occurs in every new position of the erect posture; particularly in walking and running, when the centre of gravity is alternately transferred from the foot which leaves, to that foot which meets the ground.

The manner in which the pelvis is attached to the thigh-bones, is admirably contrived to facilitate those rapid changes. The pelvis, with the weight of the whole trunk which rests upon it, is immediately supported by the ilio femoral articulations, which are placed nearer to the pubes than to the sacrum; by which conformation, the length of the lever is favourable to those muscles which are attached to the pelvis for the support of the spinal column; while, at the same time, the oblique direction of the neck of the femur, and the manner in which the head is received in the acetabulum, is calculated to support the vertical pressure of the pelvis, and to prevent the tendency of separation of the ilia from the wedge-like articulation of the sacrum. And further, the equilibrium of the pelvis is maintained by a large mass of muscles, which have their attachments to the pelvis, and the femora, both anteriorly and posteriorly.

After these preliminary remarks, we may proceed to mention the motions of the hip-joint; which, like all other enarthrodial articulations, extend in almost every direction, but not to the same extent as those joints which have less weight to support.

The direction of these motions has been classed into those of flexion, as when the thigh is directed forwards upon the pelvis; extension, when carried backwards; abduction, when the thighs are separated; adduction, when approximated; rotation, when the knee is turned outwards or inwards; and circumduction, which is the quick succession of all these motions.

Flexion of the hip-joint, is performed principally by the psoas magnus, iliacus, and pectineus, which, being the first muscles of the lower extremity put in action in progression, are termed the progressors; but flexion is further assisted by other muscles of the hip-joint; namely, the adductor femoris, tensor vaginæ femoris, obturator externus; and perhaps some few of the anterior fibres of the glutæi, as well as the gracilis and sartorius, two muscles of the knee-joint: all these muscles, excepting the first three, have other direct functions to perform.

Extension of the hip-joint, is effected principally by the three glutæi muscles, aided however by the obturator internus, gemini, quadratus femoris, and adductor magnus, all muscles of the hip-joint; and by the semitendinosus, semimembranosus, and long head of the biceps, which are muscles of the knee-joint.

Abduction of the hip-joint, is performed by the three glutæi, tensor vaginæ femoris, pyriformis, gemini, and obturator internus of the hip, and sartorius of the knee-joint; the three glutæi are to be considered as the principal muscles in abduction.

Adduction of the hip-joint, is produced by the adductor triceps femoris, the quadratus femoris, obturator externus, pectineus, psoas magnus, and iliacus of the hip; semitendinosus, semimembranosus, long head of the biceps, and gracilis, of the knee-joint.

Rotation outwards, by the pyriformis, gemini, obturatores, and quadratus femoris; assisted by the iliacus, psoas magnus, glutæus magnus, medius, and triceps adductor femoris; all of the hip-joint.

Rotation inwards, by the tensor vaginæ femoris, anterior fibres of the glutæus medius and minimus; assisted by the sartorius, gracilis, and semitendinosus of the knee-joint.

All these muscles successively in action, produce circumduction of the hip-joint, assisted by motions of the trunk; and when the thigh-bones are fixed, corresponding motions are produced of the pelvis.

In taking a retrospective view of the motions of the hip, and comparing the functions of this joint with those of the shoulder, we may observe a considerable difference, in the pelvis not being in the same manner capable of accommodating itself to the motions of the femora, as the scapulæ are to the humeri; hence we should be inclined to believe, that luxation would be much more liable to occur in the hip than in the shoulder, from the greater weight it has to sustain, and the more frequent occurrence of violent exertion. The manner, however, in which the heads of the femora are surrounded by the acetabula, and the angle at which (by the obliquity of the neck) they are connected with the shaft of the bone, tends materially to lessen the frequency of dislocation.

The student, to comprehend the great variety of action in the muscles of the hip-joint during its motions, should not detach them until he has examined with careful attention the following combinations; as in the reciprocal contraction of the flexors and abductors, adductors and extensors, extensors and adductors, then adductors and flexors; which succession of combination, produces circumduction of the limb.

As in the upper extremity the motions of the joints are more limited as they descend, so in the lower extremities, the motions of the knee are less extensive and varied than in the joint above.

The motions of the knee, are flexion and extension, for which different sets of muscles are provided; but independent of flexion and extension, the exertion of these muscles is constantly called forth, in conjunction with those of the hip, to maintain the erect position of the body, by fixing the knee-joint, and confining the condyles of the femur in a steady position upon the head of the tibia; for this purpose, muscles surround the joint in every direction.

The muscles of the knee-joint, are flexors and extensors.

The *flexors* are the gracilis, sartorius, semimembranosus, semitendinosus, biceps, and poplitæus, assisted by the gastrocnemius, and plantaris, muscles of the ancle-joint; while, through the medium of the fascia lata, the glutæus maximus and tensor vaginæ femoris may be said to cooperate.

The *extensors* are the rectus, cruræus, and two vasti, assisted by the tensor vaginæ femoris and glutæus maximus;

the two latter muscles being thus capable of performing either flexion or extension, when the limb is placed in certain positions by the other muscles.

The ancle-joint is capable of flexion and extension, and a slight inflexion outwards and inwards. These latter motions only occur in just reference to the ancle-joint, when the foot is extended, in which position the smaller portion of the articular surface of the astragalus is admitted between the malleoli, and allows of this motion. When the bones of the leg rest on the astragalus at a right angle, or during flexion of the foot, then the larger part of the astragalus is fixed between the malleoli, and the rotatory motion communicated to the foot depends upon the motions of the knee and hip; and wholly to the latter, when the knee is extended.

The *flexors* of the ancle-joint, are the tibialis anticus, and peroneus tertius, as proper to the joint; assisted, however, by the extensor longus digitorum, and extensor pollicis.

The *extensors* are the gastrocnemius, soleus, plantaris, tibialis posticus, peroneus longus and brevis; assisted by the flexor longus digitorum, and flexor longus pollicis.

Inflexion inwards — tibialis posticus, extensor pollicis, flexor longus pollicis, flexor longus digitorum.

Inflexion outwards—peroneus longus, brevis, and tertius; assisted by the extensor longus digitorum.

Motions of the bones of the tarsus and metatarsus are extremely limited, being chiefly confined to the elasticity of their cartilaginous surfaces, and can scarcely be said to depend upon the contraction of muscles, although tendons are so inserted into and interwoven on their surfaces, that their chief action on the bones of the foot depend on the preservation of the strong arches which support the weight of the body; at the same time giving to the foot its great elasticity.

The motions of the toes are much more limited than of the fingers, which no doubt depend, in a great measure, upon their disuse, as well as the manner in which the foot is clothed. The toes have, similar to the fingers, their common and proper muscles.

The *common flexors* to the toes, are the lumbricales, which are inserted into the first phalanx of the four lesser toes; the flexor brevis digitorum, into the second; and the flexor longus, into the third, or extreme phalanx: these muscles assist also in the extension of the ancle-joint.

The *common extensors,* are the extensor longus, and brevis digitorum communis, which form a common aponeurotic expansion over the dorsal surface of the toes; assisted by the interossei. The two former muscles contribute also to the flexion of the ancle-joint.

Abduction and *adduction* of the three middle toes, are performed by the interossei.

The great toe has all its motions performed by muscles proper to it; namely, its two flexors, an extensor, an abductor, and an adductor muscle.

The little toe has two proper muscles, a flexor brevis, and an abductor.

The os calcis forming the principal fixed point of the bones of the foot, and several of the muscles of the toes taking their origin from it, they contribute in a great measure to maintain the longitudinal arch of the foot; while at the same time their flexion and abduction of the great and little toes, contribute to the elasticity of the foot, and its adaptation to the various surfaces it is brought in contact with in progression.

It is to be observed, also, that the motions of the different joints of the lower extremity are much combined with each other, and in their greatest exertions unite their forces; thus at the time the respective muscles are fixing the hip and knee for the support of the weight of the body, the muscles of the leg are acting for the same purpose upon the foot and ancle.

This combination of action tends materially to lessen the force of pressure and concussion, which would otherwise be liable to produce the frequent rupture of tendon and muscle;

and it may be remarked, that when these accidents do occur, it is under circumstances where the muscles were not prepared to meet the force. At the same time, this combination of force in several muscles allows of a change of action, one set relieving the other, or acting with increased or lessened force alternately, during long-continued exertion; this is exemplified by the natural habit of resting alternately on one leg or the other when standing in the erect posture.

Having noticed the particular action of muscles individually, I shall now proceed to make some few observations on the muscular motions of the body in general.

The effects of muscular contraction upon the skeleton, are, to determine the attitudes and motions of the body, the movements of the skin, and the organs of the senses; to regulate the voice; and, lastly, to contribute more or less to the performance of the vegetative functions, as the circulation of the blood and its various consequences.

We shall, however, now more particularly dwell upon the various phenomena connected with locomotion, which are so essential to the animal economy that we find, even in the lower animals, the configuration of their bodies is in a great measure directed by it; as may be observed in the various forms of animals of different species.

In the erect posture, as we have already mentioned, the whole of the muscles of the spine and joints of the lower extremity are called into action, so that by the continued cooperation of so many muscles at the same time, we find there is a great expenditure of muscular power, and energy, to produce what apparently is a passive position; for this reason it is that persons who are much debilitated by sickness, or age, cannot long remain in the standing attitude, and even with difficulty maintain the body in a half erect position.

When standing firmly, the foot is pressed upon the ground by the flexores digitorum communes, by the flexores pollicis, the peroneus longus, tibialis posticus, and the muscles of the sole of the foot; by which action the pressure will be greatest at the heel and the toes: and owing to the arch thus strongly maintained in the foot, we are enabled to incline the body either forwards or backwards, so as materially to lessen the fatigue of standing. When carrying heavy burdens, or in consequence of some other great exertion of the body, the longitudinal arch of the foot is diminished, and flattened, and at the same time the foot directed inwards, it presents a larger surface in contact with the ground, which principally enables the individual to stand with greater security.

Standing on tiptoes is effected by the strong extensors of the ancle-joint raising the heel from the ground, while the flexors on the sole of the foot are pressing the toes downwards; the extensors of the toes and flexors of the ancle-joint are in action at the same time to bring the tibia forwards within the centre of gravity.

Walking is less fatiguing than standing, in consequence of the frequent change which takes place in the exertion of different muscles, during which they are alternately in a state of rest and action. Walking is effected, first, by throwing the weight of the body upon one lower extremity, which sets the other at liberty; then the flexors of the hip-joint, by flexing the thigh upon the pelvis, raise the foot from the ground; next the four extensors of the knee-joint advance the leg, while the extensors of the ancle-joint point the advanced foot: the muscles of the opposite firmly fixed limb, having their purchase on the ground, bend the trunk forwards in an oblique direction, so as to throw the weight towards the extended limb, which now receives it, carries it to the ground, where its principal force is met upon the heel, from whence it is transmitted to the rest of the foot; and the body is further advanced by the propelling action of the other foot on leaving the ground, and which, in its turn, goes through the same motions. In the transmission of the weight of the body from the heel to the toes, the foot forms a parabolic curve, which, together with the arches of the foot, materially diminishes the concussion which would otherwise occur.

A remarkable difference occurs in the gait of different people in the act of walking, and in some instances sufficiently demonstrable to form a national distinction; this depends upon different causes, and is more especially to be observed between the inhabitants of mountains, and sandy districts; in the former, the knees are bent, with the body directed forwards; while in the latter, the foot is placed flat upon the ground, for the purpose of affording a larger surface of resistance than could be presented by the heel.

It is obvious, in walking in a straight line, that the motions described by each lower extremity, must be equal; without which, the body will turn from that side in which the motion is greater. In walking up hill, the increased fatigue is owing to the exertion which is required in the greater flexion of the limb which is carried forward and upwards; while the limb behind has not only to move upon the pelvis, but to raise the whole weight of the body, in order to transmit its weight to the elevated and advanced limb.

Running differs from walking in the quickness with which the weight of the body is transmitted from one limb to the other; during which, a period occurs when both feet are off the ground, the body being thrown forwards and upwards by the hinder foot springing upwards before the advanced one reaches the ground; hence running approaches to a continued succession of leaps from one leg.

In *jumping*, the articulations of the lower extremities are considerably bent, and then being suddenly and powerfully extended, the body is pushed, as it were, from the ground; while at the same time, the arms are raised and directed forwards, to give the muscles attached to the upper extremities and trunk a power of drawing the body forwards: this assistance from the upper extremities, is principally required when jumping a distance; for when leaping a height, the body is maintained in an upright direction.

Swimming.—It is doubtful whether or not this power is natural to man; but, perhaps, the circumstance of his specific gravity being less than that of sea water, would lead to the belief that it was intended as a means of self-preservation. Progressive motion through the medium of the water is performed by throwing the body prone upon its surface, so as to produce the greatest extent of resistance; at the same time keeping the head above the water in order to be able to breathe freely; and then, by sudden and alternate flexions and extensions of the limbs in such a direction as to drive the water backwards, the body is propelled forwards, and, by expert swimmers, with considerable facility and quickness. Although the exertion is great, yet, by a judicious economy of the muscular power, and by gentle respiration, this action may be for a length of time maintained; and a distance of three or four miles passed through this resisting medium.

Practical Remarks.

Connected with the lower extremity; this part, as in others where it is necessary to describe extent of surface, should, for the facility of description, be divided into different regions.

The region of the hip, is bounded above by the pelvis, and below by an horizontal line drawn around the upper part of the thigh, upon a level with the perineum. The superior part of this region, posteriorly, is called the buttock, and comprehends the projection formed by the large glutæi muscles; anteriorly, this region is comprehended between an imaginary line drawn from the anterior and superior spinous process of the ilium to the pubes, above; and the line forming the inferior boundary of this region just mentioned, below; laterally and externally, this region is bounded between the spinous process of the ilium above, and the trochanter major below.

The pupil should observe in the healthy subject the symmetrical form of this region, and remark particularly the exact correspondence of the two sides; any deviation from which, is a general indication of disease or accident.

Beginning in the posterior part of this region—the fulness of either buttock may be increased or diminished from its natural form; the former will occur in abscesses, and during the acute stage of diseases of the hip-joint; the latter, in dislocations, and from the wasting of the muscles in various diseases.

The anterior part of this region is of considerable importance, being the seat of hernia, aneurism, abscess, and glandular tumours; each of which disease is accompanied by alteration in the natural form of the part, and are treated of when speaking of the particular organs connected with the disease. One disease of particular surgical importance connected with the muscles of the hip-joint, may now with propriety be mentioned. Between the tendinous insertion of the psoas and iliacus, and the trochanter minor, the bursa mucosa there situated will occasionally secrete an inordinate quantity of synovia, which projects forwards into the thigh, presenting a tumour, which may be mistaken for abscess or femoral hernia; in such cases a just diagnosis can only be formed by strict attention to the previous symptoms, and history of the case. Considerable surgical importance is also attached to a familiar knowledge of the form of the external surface of this region, where the situation of the trochanter major, its distance from the anterior and superior spinous process of the ilium, and its capability of rotation outwards or inwards, severally indicate the nature of dislocations and diseases of the hip-joint.

The perineal surface of the anterior portion of this region, is the seat of extravasation of urine, when the urethra has given way between the two fasciæ of the perinæum.

The surgical operations connected with the arteries of this part of the body, will be mentioned when treating of the blood-vessels generally.

The femoral region comprehends the whole of the thigh, between the line before mentioned and the knee. With respect to the skin, it is found softer and thinner on the inner than on the outer and back part of the thigh. Beneath the skin, and between it and the fascia upon the upper and anterior part of the femoral region, is situated several small absorbent glands, which are the frequent seats of inflammation and abscess, requiring the evacuation of their contents; but even in this simple operation, the situation of these abscesses renders it of importance, as they may be confounded with hernia;—a circumstance I have twice known to occur, and with fatal consequences. The number of nerves and veins which pervade this region of the lower extremity, between the skin and fascia, render superficial wounds of this part important, from the consequent degree of pain and hæmorrhage which follows. The fascia lata of the thigh, from its little tendency to ulcerate, forms a strong barrier to the escape of matter, and consequently produces a corresponding constitutional irritation; to obviate which, early openings should be made, unless connected with the lumbar region, when much caution is necessary. The evacuation of the matter in relation to the two bags formed by the fascia lata on the posterior and anterior part of the thigh, requires the same precaution as was noticed when speaking of abscess under the fascia of the arm. In the circular amputation of the thigh, the first incision should be made through the skin only, in order to allow the skin to be retracted readily on the surface of the fascia lata. I may also, in speaking of the circular amputation, mention, that the artery will be differently situated according to the part of the limb cut through: for instance, if on a level with the aponeurotic arch of the adductor magnus, the artery will be found on the inner side of the stump; if below this point, it is placed posteriorly; and if above it, anteriorly and internally.

The bursa mucosa situated under the common tendon to the extensors of the knee, forms the boundary, below which, it is not proper to amputate the thigh. Wounds in this part, which open into the synovial sac, are tedious to heal; and dangerous, should a high degree of inflammation follow, and extend to the knee-joint. Hence, in these accidents, the necessity of placing a splint behind the knee, so as to preclude the possibility of motion.

The lower and posterior third of the femoral region is termed the popliteal space, in which is situated the popliteal vessels, and posterior tibial nerve, as well as a considerable quantity of cellular and adipose membranes, with absorbent glands. In this region, the adipose membrane is sometimes the seat of a fatty tumour, termed steatoma; when from their size it becomes necessary to remove such tumours, the depth of their situation, and their connection with the important vessels of the part, renders this operation one of considerable difficulty.

In the leg, the fascia ties down the muscles so firmly, that when the subjacent parts are injured and swollen, gangrene will occasionally follow, from its great pressure and unyielding nature: to relieve this, early and free openings should be made.

In the region of the foot, the most remarkable surgical points to be attended to, are the various projections formed by the several processes of the bones of the ancle, tarsus, and metatarsus; a correct knowledge of which is necessary, as they form the guide in the amputations which are performed upon this part of the body; as, for instance, in Chopart's operation, and other partial amputations.

The great degree of tensity in the skin of the foot renders it necessary to preserve a large proportion of integument in partial amputations, so as to leave a sufficient covering to the projecting bones; and for the same reasons, a larger flap is required on the inner than on the outer side of the foot.

The great thickness of the skin on the sole of the foot, and its strong connection by dense aponeurotic fibres to the plantar fascia, offers considerable resistance to the swelling of this part from any morbid cause; hence the formation of matter in this part produces excessive pain and constitutional irritation, which is to be relieved by early openings. The skin on the dorsum of the foot, is thin, and affords but little protection to the subjacent parts; hence wounds are more liable to occasion injury to the blood-vessels and tendons here situated; and the tense state of the skin, forms a considerable obstacle to the process of cicatrization.

CLASSIFICATION OF MUSCLES,

ACCORDING TO THE FOREGOING DESCRIPTION.

Muscles of the Abdomen.

Obliquus abdominis externus.
Obliquus abdominis internus.
Transversus abdominus.
Rectus abdominis.
Pyramidalis.
The cremaster muscle—a continuation of some of the fibres of the internal oblique and transversalis.

Muscles of the Exterior of the Cranium and Face.

Orbicularis palpebræ.

Corrugator supercilii - - Occipito frontalis - - - Levator palpebræ superioris	Moderators to the orbiculares palpebrarum.

Orbicularis oris.

Compressor naris - - - Levator labii superioris alæque nasi Depressor labii superioris alæque nasi Levator anguli oris - - - Zygomaticus major - - - Zygomaticus minor - - - Buccinator - - - - Levator labii inferioris - - Depressor labii inferioris - - Depressor anguli oris - -	Moderators to the orbicularis oris.

Muscles superficially situated on the anterior part of the Neck.

Platysma myoides.
Sterno cleido mastoideus.

Muscles which fix the Os Hyoides.

Sterno hyoideus.
Sterno thyroideus.
Thyro hyoideus.
Omo hyoideus.
Stylo hyoideus.

Muscles which depress the Lower Jaw.

Digastricus.
Mylo hyoideus.
Genio hyoideus.
Genio hyo glossus.

Muscles of Mastication.

Temporalis.
Masseter.
Pterygoideus internus.
Pterygoideus externus.

Muscles of the Tongue.

Genio hyo glossus.
Lingualis.
Hyo glossus.
Stylo glossus.

Muscles of the Fauces and soft Palate.

Constrictor isthmi faucium Palato pharyngeus - - Azygos uvulæ - - -	Forming the soft palate.
Circumflexus palati - - Levator palati mollis -	Moving the soft palate.

Muscles of the Pharynx.

Constrictor pharyngis inferior.
Constrictor pharyngis medius.
Constrictor pharyngis superior.
Stylo pharyngeus.

MUSCLES OF THE UPPER EXTREMITY.

Muscles which attach the Scapula to the Trunk.

Trapezius.
Rhomboideus major.
Rhomboideus minor.
Levator scapulæ.
Omo hyoideus.
Pectoralis minor.
Subclavius.
Serratus magnus.

Muscles of the Shoulder-Joint.

Pectoralis major.
Latissimus dorsi.
Deltoides.
Supra spinatus.
Infra spinatus.
Teres minor.
Subscapularis.
Teres major.
Coraco brachialis.

Muscles of the Elbow-Joint.

Biceps cubiti.
Brachialis internus.
Triceps extensor cubiti.
Anconeus.

Muscles between the Radius and Ulna, anteriorly.

Superficial layer :—

Pronator radii teres.
Flexor carpi radialis.
Palmaris longus.
Flexor digitorum sublimis vel perforatus.
Flexor carpi ulnaris.

Deep seated layer :—

Flexor digitorum profundus vel perforans.
Flexor tertii internodii vel longus pollicis manus.
Pronator quadratus.

Muscles between the Radius and Ulna, posteriorly.

Superficial layer :—

Supinator radii longus.
Extensor carpi radialis longior.
Extensor carpi radialis brevior.
Extensor digitorum communis.
Extensor carpi ulnaris.
Anconeus.

Deep layer :—

Supinator radii brevis.
Extensor primi internodii pollicis, or extensor ossis metacarpi.
Extensor secundi internodii pollicis.
Extensor tertii internodii pollicis.
Extensor indicis.

Muscles of the Palm of the Hand.

Palmaris brevis.
Lumbricales.

Abductor pollicis - - -	Proper to the thumb.
Flexor primi internodii, vel apponeus pollicis	
Flexor secundi internodii, vel brevis pollicis	
Adductor pollicis - - -	

Abductor indicis—proper to the fore finger.

Abductor minimi digiti -	Proper to the little finger.
Flexor brevis minimi digiti	
Adductor minimi digiti -	

Interossei.

Muscles of the Back.

For the first and second layers, *vide* p. 150.

Third layer:—
Serratus posticus superior.
Serratus posticus inferior.

Fourth layer:—
Sacro lumbalis.
Longissimus dorsi.
Spinalis dorsi.
Splenius.

Fifth layer:—
Cervicalis ascendens.
Transversalis colli.
Trachelo mastoideus.
Complexus.

Sixth layer:—
Rectus capitis posticus major.
Rectus capitis posticus minor.
Obliquus capitis superior.
Obliquus capitis inferior.
Semispinalis colli.
Semispinalis dorsi.

Seventh layer:—
Multifidi spinæ.
Interspinales cervicis, dorsi, et lumborum.

Muscles deeply-seated on the anterior surface of the Neck.

Longus colli.
Rectus capitis anticus major.
Rectus capitis anticus minor.

Muscle deeply-seated on the anterior surface of the Lumbar Vertebræ.

Psoas parvus.

Muscles situated deeply on the lateral aspects of the Spine.

Rectus capitis lateralis.
Scalenus anticus.

Scalenus medius.
Scalenus posticus.
Intertransversales cervici, dorsi, et lumborum.

Muscles attached to the Thorax, and directly employed in Respiration.

Intercostales externi.
Intercostales interni.
Triangularis sterni.
Diaphragma.
Quadratus lumborum.

Muscles of the Perinæum.

Sphincter ani.
Accelerator urinæ.
Erector penis.
Transversus perinæi.
Levator ani.
Coccygeus.
Erector clitoridis.
Constrictor vaginæ.

MUSCLES OF THE LOWER EXTREMITY.

Muscles of the Hip-Joint.

Psoas magnus.
Iliacus internus.
Pectineus.
Glutæus maximus.
Glutæus medius.
Glutæus minimus.
Pyriformis.
Geminus superior.
Obturator internus.
Geminus inferior.
Quadratus femoris.
Triceps adductor femoris.
Obturator externus.
Tensor vaginæ femoris.

Muscles of the Knee-Joint.

Rectus femoris.
Cruræus.
Vastus externus.
Vastus internus.
Sartorius.
Gracilis.
Semitendinosus.
Semimembranosus.
Biceps flexor cruris.
Popliteus.

Muscles posterior to the Tibia and Fibula.

Superficial layer:—

Gastrocnemius.
Plantaris.
Soleus.

Deep seated layer:—

Tibialis posticus.
Flexor longus communis digitorum pedis.
Flexor longus pollicis pedis.

Muscles anterior to the Tibia and Fibula.

Tibialis anticus.
Extensor longus digitorum pedis.
Peroneus tertius.
Extensor proprius pollicis pedis.

Muscles situated on the outer side of the Leg.

Peroneus longus.
Peroneus brevis.

Muscles of the Foot.

First layer:—

Flexor brevis digitorum pedis perforatus.

Abductor pollicis pedis.
Abductor minimi digiti pedis.

Second layer:—

Accessorius ad flexores digitorum pedis.
Lumbricales pedis.
Extensor longus digitorum pedis.
Extensor longus pollicis pedis.

Third layer:—

Flexor brevis pollicis pedis.
Adductor pollicis pedis.
Transversus pedis.
Flexor brevis minimi digiti pedis.

Fourth layer:—

Interossei plantaris interni vel inferiores.
Tendon of the tibialis posticus.

Muscles situated on the Dorsum of the Foot.

Interossei externi vel superiores.
Extensor brevis digitorum pedis.

TABLE OF THE MUSCLES,

ARRANGED ACCORDING TO THEIR ATTACHMENTS TO THE BONES.

Muscles arising from the Os Frontis.

Temporales.
Corrugatores supercilii.
Orbiculares palpebrarum.

Muscles inserted into the Os Frontis.

Occipito frontalis.

Muscles arising from the Ossa Parietalia.

Temporales.

Muscles arising from the Os Occipitis.

Occipito frontales.
Trapezii.
Constrictor pharyngis superior.

Muscles inserted into the Os Occipitis.

Sterno cleido mastoidei.
Splenii.
Complexi.
Recti capitis postici majores.
Recti capitis postici minores.
Recti capitis laterales.
Recti capitis antici majores.
Recti capitis antici minores.
Obliqui superiores.
Constrictor pharyngis medius.

Muscles arising from the Ossa Temporum.

Occipito frontales.
Masseteres.
Temporales.
Dygastrici.
Stylo glossi.
Stylo hyoidei.
Stylo pharyngei.
Levatores palati.
Tensores tympani.
Levatores tympani.
Stapedei.
Retrahentes aurem.
Anteriores auris.

Muscles inserted into the Ossa Temporum.

Sterno cleido mastoidei.
Splenii capitis.
Trachelo mastoidei.

Muscles arising from the Os Sphenoides.

Levatores palpebrarum superiorum.
Levatores occulorum.
Depressores occulorum.
Adductores occulorum.
Abductores occulorum.
Obliqui superiores occulorum.
Temporales.
Pterygoidii externi.
Pterygoidii interni.
Buccinatores.
Constrictor pharyngis superior.
Tensores palati.
Externi mallei.
Tensores tympani.

Muscles inserted into the Ossa Nasi.

Compressores narium.
Occipito frontales.

Muscles arising from the Ossa Malarum.

Zygomatici majores.
Zygomatici minores.
Masseteres.
Orbiculares palpebrarum.

Muscles arising from the Ossa Maxillaria Superiora.

Masseteres.
Constrictor pharyngis superior.
Pterygoidei externi.
Buccinatores.
Levatores angulorum oris.
Levatores labii superiores alarumque nasi.
Depressores labii superiores alarumque nasi.
Orbiculares palbebrarum.
Obliqui occulorum inferiores.
Compressores narium.

Muscles arising from the Ossa Palati.

Pterygoidei externi.
Pterygoidei interni.
Buccinatores.
Constrictor pharyngis superior.
Azygos uvulæ.

Muscles inserted into the Ossa Palati.

Circumflexores palati.

Muscles arising from the Os Maxillare Inferius.

Depressores labii inferioris.
Depressores angulorum oris.
Levatores labii inferioris.

Buccinatores.
Mylo hyoidei.
Genio hyoidei.
Genio hyo glossi.
Constrictor pharyngis superior.

Muscles inserted into the Os Maxillare Inferius.

Temporales.
Masseteres.
Pterygoidei interni.
Pterygoidei externi.
Digastrici.
Platysma myoides.

Muscles arising from the Os Hyoides.

Digastrici.
Hyo glossi.
Constrictor pharyngis medius.

Muscles inserted into the Os Hyoides.

Mylo hyoidei.
Genio hyoidei.
Genio hyo glossi.
Stylo hyoidei.
Sterno hyoidei.
Omo hyoidei.
Thyro hyoidei.

Muscles arising from the Clavicle.

Pectoralis major - - } Of the shoulder-joint.
Deltoides - - - - }
Sterno mastoideus.
Sterno hyoideus.

Muscles inserted into the Clavicle.

Subclavius.
Trapezius.

Muscles arising from the Scapula.

Omo hyoideus—attaching the scapula to the trunk.

Deltoides - - - -	Of the shoulder-joint.
Supra spinatus - -	
Infra spinatus - - -	
Subscapularis - - -	
Teres major - - -	
Teres minor - - -	
Coraco brachialis -	
Latissimus dorsi - -	
Biceps - - - - -	Of the elbow-joint.
Triceps - - - - -	

Muscles inserted into the Scapula.

Levator scapulæ - -	Muscles attaching the scapula to the trunk.
Rhomboideus major -	
Rhomboideus minor -	
Serratus anticus - -	
Pectoralis minor - -	
Trapezius - - - -	

Muscles arising from the Humerus.

Brachialis internus -	Of the elbow-joint.
Triceps - - - - -	
Anconeus - - - -	
Pronator radii teres - - - -	Of the radio ulnar articulations.
Supinator radii longus - - -	
Supinator radii brevis - - - -	
Flexor carpi radialis - - - -	Of the wrist-joint.
Palmaris longus - - - - -	
Flexor carpi ulnaris - - - -	
Extensor carpi radialis longior -	
Extensor carpi radialis brevior -	
Extensor carpi ulnaris - - - -	
Flexor digitorum perforatus - -	Common to the fingers.
Extensor digitorum communis -	

Flexor longus pollicis—proper to the thumb.

Muscles inserted into the Humerus.

Deltoides - - - - - - -	Of the shoulder-joint.
Supra spinatus - - - - - -	
Infra spinatus - - - - - -	
Teres minor - - - - - - -	
Subscapularis - - - - - -	
Pectoralis major - - - - -	
Latissimus dorsi - - - - -	
Teres major - - - - - - -	
Coraco brachialis - - - - -	

Muscles arising from the Radius.

Flexor sublimis digitorum—common to the fingers.

Flexor longus pollicis - - - -	Proper to the thumb.
Extensor primi internodii - - -	

Muscles inserted into the Radius.

Biceps—of the elbow-joint.

Pronator radii teres - - - -	Of the radio ulnar joints.
Pronator quadratus[1] - - - -	
Supinator radii longus - - -	
Supinator radii brevis - - - -	

Muscles arising from the Ulna.

Supinator radii brevis - - - -	Of the radio ulnar articulations.
Pronator radii teres - - - -	
Pronator quadratus - - - -	
Flexor carpi ulnaris - - - -	Of the wrist-joint.
Flexor carpi radialis - - - -	
Extensor carpi ulnaris - - -	
Flexor sublimis digitorum - -	Common to the fingers.
Flexor profundus digitorum - -	
Extensor primi internodii pollicis	Proper to the thumb.
Extensor secundi internodii pollicis	
Extensor tertii internodii pollicis	

Extensor indicis—proper to the fore finger.

Muscles inserted into the Ulna.

Brachialis internus - - - - - } Of the elbow-joint.
Anconeus - - - - - - - - } Of the elbow-joint.
Triceps - - - - - - - - - } Of the elbow-joint.

Muscles arising from the Os Pisiforme.

Abductor minimi digiti—proper to the little finger.

Muscles inserted into the Os Pisiforme.

Flexor carpi ulnaris—of the wrist-joint.

Muscles arising from the Os Trapezium.

Flexor primi internodii pollicis - } Proper to the thumb.
Flexor secundi internodii pollicis } Proper to the thumb.
Abductor pollicis - - - - - } Proper to the thumb.
Abductor indicis—proper to the fore finger.

Muscles inserted into the Os Trapezium.

Extensor primi internodii pollicis.

Muscles arising from the Os Trapezoides and Os Magnum.

Flexor secundi internodii.

Muscles arising from the Os Unciforme.

Flexor secundi internodii pollicis.
Flexor brevis minimi digiti.
Abductor minimi digiti.

Muscles arising from the Metacarpal-bone of the Fore Finger.

Interossii.

Muscles inserted into the Metacarpal-bone of the Fore Finger.

Flexor carpi radialis.
Extensor carpi radialis longior.

Muscles arising from the Metacarpal-bone of the Middle Finger.

Adductor pollicis.
Interossii.

Muscles inserted into the Metacarpal-bone of the Middle Finger.

Extensor carpi radialis brevior.

Muscles arising from the Metacarpal-bone of the Ring Finger.

Interossii.

Muscle arising from the Metacarpal-bone of the Little Finger.

Interossei.

Muscles inserted into the Metacarpal-bone of the Little Finger.

Adductor minimi digiti.
Extensor carpi ulnaris.

Muscles arising from the First Phalanx of the Thumb.

Abductor indicis.

Muscles inserted into the Phalanges of the Thumb, and their Ossa Sessamoidea.

Flexor primi internodii - - Extensor primi internodii -	To the first phalanx.
Adductor pollicis Abductor pollicis	To the ossa sessamoidea, between the first and second phalanges.
Flexor secundi internodii - Extensor secundi internodii	To the second phalanx.
Flexor tertii internodii - - Extensor tertii internodii -	To the third phalanx.

Muscles inserted into the Phalanges of the Fore Finger.

Lumbricales.
Extensor indicis.
Abductor indicis.
Extensor digitorum communis.
Flexor sublimis perforatus.
Flexor profundus perforans.

Muscles inserted into the Phalanges of the Middle and Ring Fingers.

Lumbricales.
Flexor sublimis perforatus.
Flexor profundus perforans.
Extensor digitorum communis.

Muscles inserted into the Phalanges of the Little Finger.

Lumbricales.
Flexor brevis minimi digiti.
Abductor minimi digiti.
Extensor digitorum communis.
Flexor sublimis perforatus.
Flexor profundus perforans.

Muscles arising from the Spine.

Trapezii.
Latissimi dorsi.
Rhomboidei majores.
Rhomboidei minores.
Levatores scapulæ.
Serrati postici superiores.
Serrati postici inferiores.
Splenii.
Sacro lumbales.
Longissimi dorsi.
Spinales dorsi.
Cervicales descendentes.

Transversales colli.
Trachelo mastoidei.
Complexi.
Recti capitis postici majores.
Recti capitis postici minores.
Obliqui capitis superiores.
Obliqui capitis inferiores.
Semispinales dorsi.
Semispinales colli.
Multifidi spinæ.
Intertransversales.
Interspinales.
Levatores costarum.
Obliqui abdominis interni.
Longi colli.
Recti capitis anteriores majores.
Recti capitis anteriores minores.
Recti capitis laterales.
Diaphragma.
Psoæ magni.
Iliaci interni.
Psoæ parvi.
Scaleni antici.
Scaleni medii.
Scaleni postici.
Transversales abdominis.

Muscles inserted into the Spine.

Splenii colli.
Sacro lumbales.
Longissimi dorsi.
Spinales dorsi.
Cervicales descendentes.
Transversales colli.
Obliqui capitis inferiores.
Semispinales dorsi.
Semispinales colli.

Multifidi spinæ.
Intertransversales.
Interspinales.
Longi colli.
Quadrati lumborum.

Muscles arising from the Sternum.

Pectorales majores.
Sterno cleido mastoidei.
Sterno hyoidei.
Sterno thyroidei.
Sterno costales.
Diaphragma.
Intercostales interni.

Muscles inserted into the Sternum.

Recti abdominis.
Obliqui abdominis interni.

Muscles arising from the Ribs.

Intercostales externi.
Intercostales interni.
Diaphragma.
Sterno hyoidei.
Sterno thyroidei.
Subclavii.
Pectorales majores.
Pectorales minores.
Latissimi dorsi.
Serrati majores antici.
Cervicales descendentes.
Obliqui abdominis externi.
Transversales abdominis.

Muscles inserted into the Ribs.

Levatores costarum.
Intercostales interni.

Intercostales externi.
Sterno costales.
Quadrati lumborum.
Scaleni antici.
Scaleni medii.
Scaleni postici.
Serrati postici superiores.
Serrati postici inferiores.
Sacro lumbales.
Accessorii ad sacro lumbales.
Longissimi dorsi.
Obliqui interni abdominis.
Recti abdominis.

Muscles arising from the Sacrum.

Latissimi dorsi.
Obliqui abdominis interni.
Longissimi dorsi.
Sacro Lumbales.
Multifidi spinæ.
Glutæi maximi.
Pyriformes.

Muscles inserted into the Sacrum.

Coccygei.

Muscles arising from the Os Coccygis.

Glutæi maximi.

Muscles inserted into tbe Os Coccygis.

Coccygei.
Levatores ani.
Sphincter ani.

Muscles arising from the Ossa Ilia.

Obliqui interni abdominis - - - } Muscles of the
Transversales abdominis - - - } abdomen.

Latissimi dorsi - - - -	Muscles of the back.
Longissimi dorsi - - -	
Sacro lumbales - - - -	
Multifidi spinæ - - - -	
Quadrati lumborum - -	
Iliaci interni - - - - -	Muscles of the hip-joint.
Glutæi maximi - - - -	
Glutæi medii - - - -	
Glutæi minimi - - - -	
Tensores vaginæ femoris -	
Sartorii - - - - - -	Muscles of the knee-joint.
Recti femoris - - - - -	

Muscles inserted into the Ossa Ilia.

Obliqui externi abdominis.
Psoæ parvi.

Muscles arising from the Ossa Ischia.

Erectores penis - - - -	Muscles of the perinæum.
Erectores clitoridis - - -	
Transversi perinæi - - -	
Transversi perinæi alteri -	
Levatores ani - - -	
Coccygei - - - - - -	
Gemini - - - - - -	Muscles of the hip-joint.
Obturatores externi - -	
Obturatores interni - - -	
Quadrati femoris - - -	
Tricipites adductores femoris	
Graciles - - - - - -	Muscles of the knee-joint.
Bicipites flexores crurum -	
Semitendinosi - - - -	
Semimembranosi - - -	

Muscles arising from the Ossa Pubes.

Recti abdominis - - - -	Muscles of the abdomen.
Pyramidales - - - - -	

Levatores ani—muscles of the perineum.

Obturatores externi - - -	Muscles of the hip-joint.
Obturatores interni - - -	
Pectinæi - - - - - - -	
Tricipites adductores femoris	

Graciles—muscles of the knee-joint.

Muscles inserted into the Pubes.

Obliqui externi abdominis -	Muscles of the abdomen.
Obliqui interni abdominis -	
Transversalis abdominis -	

Psoæ parvi—muscles of the pelvis.

Muscles arising from the Os Femoris.

Cruræus - - - - - - -	Of the knee-joint.
Vastus externus - - - -	
Vastus internus - - - -	
Biceps flexor cruris - - -	
Poplitæus - - - - - - -	
Gastrocnemius externus -	Of the ancle-joint.
Plantaris - - - - - - -	

Muscles inserted into the Os Femoris.

Gluteus maximus - - -	Muscles of the hip-joint.
Gluteus medius - - - -	
Gluteus minimus - - -	
Pyriformis - - - - -	
Geminus superior - - -	
Geminus inferior - - -	
Obturator externus - - -	
Obturator internus - - -	
Quadratus femoris - - -	
Psoas magnus - - - -	
Iliacus internus - - - -	
Pectinæus - - - - -	
Triceps adductor femoris -	

Muscles arising from the Tibia.

Tibialis anticus - - - - Soleus - - - - - - - Tibialis posticus - - - -	Of the ancle-joint.
Flexor longus digitorum - Extensor longus digitorum	Common to the toes.

Muscles inserted into the Patella and Tibia.

Rectus - - - - - - - Cruralis - - - - - - - Vastus externus - - - Vastus internus - - - - -	Extensors of the knee-joint.
Semimembranosus - - - Semitendinosus - - - - Sartorius - - - - - - - Gracilis - - - - - - - Popliteus - - - - - - -	Flexors of the knee-joint.

Muscles arising from the Fibula.

Peroneus longus - - - Peroneus brevis - - - - Soleus- - - - - - - - Tibialis posticus - - - -	Extensors of the ancle-joint.
Flexor longus pollicis pedis Extensor longus pollicis pedis	Proper to the great toe.

Extensor longus digitorum—common to the toes.

Muscles inserted into the Fibula.

Biceps flexor cruris—flexor of the knee.

Muscle arising from the Astragalus.

Extensor brevis digitorum pedis.

Muscle inserted into the Astragalus.

Tibialis posticus.

Muscles arising from the Os Calcis.

Extensor brevis digitorum pedis—on the dorsum.

Flexor brevis pollicis - -	On the plantar region.
Abductor pollicis - - -	
Adductor pollicis - - -	
Flexor brevis digitorum pedis	
Flexor digitorum accessorius	
Abductor minimi digiti - -	

Muscles inserted into the Os Calcis.

Gastrocnemius - - - -	Extensors of the ancle-joint.
Plantaris - - - - - - -	
Soleus - - - - - - -	

Muscle inserted into the Os Naviculare.

Tibialis posticus.

Muscles arising from the Ossa Cuneiforme.

Flexor brevis pollicis pedis	Os cuneiforme externum.
Adductor pollicis pedis -	

Muscles inserted into the three Ossa Cuneiformia.

Tibialis anticus—to the internal cuneiform bone.
Tibialis posticus—to the internal and middle.
Peroneus longus—to the os cuneiforme internum.

Muscles arising from the Os Cuboides.

Adductor pollicis pedis.
Flexor brevis minimi digiti.
Flexor brevis pollicis pedis.

Muscles arising from the Metatarsal-bones.

Interossei - - - - - - -	Common to all.
Transversus pedis - - -	

Adductor pollicis pedis—from second, third, and fourth.

Flexor brevis minimi digiti pedis	From the fifth.
Abductor minimi digiti pedis - -	

Muscles inserted into the Metatarsal-bones.

Tibialis anticus - - - -	Into the first.
Peroneus longus - - - -	
Adductor pollicis pedis -	
Tibialis posticus—into the second and middle.	
Peroneus brevis - - - -	Into the fifth.
Peroneus tertius - - - -	
Flexor brevis minimi digiti	
Abductor minimi digiti - -	

Muscles inserted into the Phalanges of the Toes.

Flexor longus digitorum pedis	Common to the toes.
Flexor brevis digitorum pedis	
Lumbricales - - - - -	
Extensor longus digitorum	
Extensor brevis digitorum -	
Interossei - - - - - -	
Flexor longus pollicis pedis	Proper to the great toe.
Flexor brevis pollicis pedis	
Abductor pollicis pedis - -	
Adductor pollicis pedis - -	
Extensor longus pollicis pedis	
Flexor brevis minimi digiti pedis	Proper to the little toe.
Abductor minimi digiti - - -	

LECTURES ON ANATOMY.

PART V.

GENERAL ANATOMY OF CELLULAR MEMBRANE, &c.

LECTURE XX.

GENERAL ANATOMY OF CELLULAR MEMBRANE.

Cellular membrane, so named from the peculiarity of its structure, is composed of numerous bluish grey fibres, crossing each other in every direction so as to form thin elastic membranes or plates, which unite, and intersect each other, producing innumerable cells or areolæ, of various shapes and dimensions.

This structure is one of the most important in the human body, both on account of its forming a principal component of every other part, and of the extensive function it performs as an organ of secretion and absorption.

The cellular membrane may, indeed, be regarded as the general basis whereon the other structures are formed, and by which they are supported and connected with each other.

Some physiologists have considered all membranous structures as so many modifications of the cellular membrane; while others have divided the cellular membrane into numerous distinct tissues: of these views, it appears to be too theoretical, on the one hand, to say that the cellular tissue, by being condensed, forms the cutis, which has the power of depositing concrete lamellæ upon its surface, named the cuticle; or, that coiled into tubes, it forms blood-vessels, &c.: so also, on the other hand, it appears to be a useless multiplication of parts, to divide the cellular membrane into the numerous tissues described by Bichat.

In its general distribution throughout the body, some variety may be observed in the different features represented in its physical properties, and function; from which circumstance, for the facility of description, it may be considered under the following heads:—

First:—As forming a general covering to the different organs, at the same time connecting them in their relative position to each other, yet allowing of the free motion of their several parts.

Secondly:—It enters into the composition of the minutest structures of the body.

Under the first of these heads, we shall commence by noticing the general covering of cellular membrane, immediately beneath the skin; in this situation it is every where inseparably connected with the under surface of the cutis, and enters so abundantly into the composition of the common integuments, that the true skin itself appears as if it were a condensation of cellular membrane upon the surface of the body. The cells are larger, and more lax, the farther they are removed from the cutis; hence the mobility which the skin enjoys principally depends upon the abundance of cellular membrane underneath. In this respect, the subcutaneous cellular membrane varies according to its situation, being generally admirably adapted to the motions of individual parts: where extensive motion is required, its fibres and plates are longer, and more elastic; while in parts where strength and support are necessary, its fibres are short and dense, and frequently mixed even with tendinous structures. These differences of texture are particularly observable in the palms of the hands, and soles of the feet; it is also dense under the integuments of the cranium, whence the motions of the scalp, from its consequent firm adhesion to the muscles underneath.

The cellular membrane is also found more dense along the mezian line which divides the trunk perpendicularly into symmetrical halves; this line passes along the spinous processes of the vertebræ and sacrum, the raphé of the perineum, scrotum, the linea alba, sternum, and centre line of the face and head. The existence of this line is evinced by the effects of emphysema, which are here checked in their progress; and artificially one half of the subcutaneous cellular membrane throughout the body has been inflated, independently of the other. On the eontrary, this structure is found more lax in the eyelids, the face, the neck, the axilla, the abdomen, the groins, the scrotum, and in the popliteal region.

The next situation in which we shall remark this strueture is, in the general eovering whieh it affords to the muscles, independent of its intimate union with their ultimate fibres.

Here also, as in the subcutaneous arrangement, it will be found more abundant in all those parts where motion is most extensive; thus in the museles of the face, where varied motion is employed in each changing expression of the features; in the neck, where the muscles are numerous, lengthened, extensive in their motions, and accompanied by numerous large blood-vessels; between the muscles of the chest, and around the mammæ; in the axillæ, where large blood-vessels, nerves, absorbents and glands are embedded, between the great muscles of the back and chest; between the muscles forming the parietes of the abdomen; in the groins, bend of the knees; and partieularly between the larger muscles of the extremities.

In the soles of the feet, and palms of the hands, the deep-seated cellular membrane, as the subeutaneous, is abundant; but in these situations it is peculiar from enclosing cells of adeps, mixed with strong tendinous fibres, forming a cushion to resist the effects of pressure on the parts underneath; a similar strueture is found, for a similar purpose, beneath the tuberosities of the ischia.

We shall next observe the covering which the eellular membrane gives to the viscera, and other important organs situated within the eavities of the body. Henee we may first observe, that the secreting glands are more or less covered with eellular membrane, independent of any motion required in these parts; sueh, for instance, is the ease with the kidney, and capsulæ renales, whieh are not only furnished with this structure external to their aponeurotic envelops, but also between them and the glands themselves.

The eellular membrane also surrounds the liver, pancreas, spleen, stomach, intestines, and bladder; and, most abundantly, at those parts where the peritoneum is separated from each organ to allow the passage of their vessels and nerves; as is seen between the folds of the omenta, mesentery, ligaments of the liver, and more especially on that portion of the bladder which is not covered with peritoneum. In the thorax, the cellular membrane will be found connecting the lungs with their pleura, and the heart with its pericardium; and as in the abdomen, is found more abundant where the serous membranes are reflected from their organs for the transmission of blood-vessels, as in the mediastina, and course of the coronary vessels to the heart.

It may be further mentioned here, that the mucous as well as the serous membranes, are attached to their respective organs by a general connecting medium of cellular membrane.

The second general distribution of the cellular mambrane, is that in which it forms so material a part of all the minute structures of the body.

So extensive is this distribution, that the physiologist is unable to say where this structure ends, and other structures commence.

In the muscles we find it, after coating them generally, enclosing their separate fasciculi, becoming thinner and thinner in its texture, as it enters more minutely into the body of each fasciculus, enclosing the minutest fibre traceable with the highest magnifying powers.

With regard to the blood-vessels, it forms a general covering, readily discerned in the larger branches; and when we consider the extent of the cellular membrane accompanying them to their ultimate ramifications, we are lost in the contemplation of its infinite minuteness and delicacy; and this is still further evinced, when we consider that a much finer layer of cellular membrane connects the internal with the muscular coat of the arteries. The same observations apply to the distribution of the cellular membrane accompanying the nervous system; we are enabled to trace it in the larger nerves giving them a strong and general covering, as in the muscles; it then incloses their minuter fasciculi, and subdivides, accompanying them to their minutest filaments.

The cellular membrane covering the absorbents is very abundant; but in close contact with the vessel, it is short and dense, and not so easily traced as in the arteries and nerves. The same remark applies to the veins; but there, however, it is more distinct than in the absorbents, from the structure of the coats of the vessels. In the substance of the glands, we find the cellular membrane less abundant, and composed of very short and delicate fibres, apparently coating the minute globules of their interior structure; this may be easily seen by tearing the substance of the liver and spleen, when minute and semitransparent fibres will be seen to separate themselves from between each globule, apparently uniting as well as surrounding them. This cellular structure of the liver is rendered particularly obvious by placing a portion in pyrolignious acid, and allowing it to remain for six weeks or two months subjected to its action; a species of decomposition will take place, by which each distinct globule is detached, and the structure of the liver beautifully demonstrated.

The minute, or ultimate structure of cellular membrane, is not clearly understood; by the assistance of the microscope we may trace innumerable whitish grey fibres, crossing each other in all directions, and by their union forming thin delicate membranes or plates; these again meet and intersect each other, so as to produce cells or areolæ. Whether these whitish fibres are blood-vessels, absorbents, or nerves, is not known, excepting from the evidence of secretion and absorption, abundantly carried on in this structure; which functions lead to the conclusion, that it must be plentifully supplied with such vessels.

With regard to the texture of the cellular tissue, it is extremely elastic; its cohesive force, however, varies; being that of a coagulated liquid in some parts of the body, whilst in others its power of resistance equals that of perfect fibres: for instance, the cellular membrane in the interior of a muscle, appears principally for the connection of its parts, and is there more distinctly fibrous: while in the axilla, and those parts destined for extensive motion, it not only forms a connecting medium, but secretes a halitus to lubricate its surface, and presents, when floated in water, a peculiar soft flosculent appearance.

The cellular membrane has a free communication between its cells, as is seen in emphysema, ecchymosis, and anarsarca; but some difference of opinion exists regarding the free permeability of this structure, it having been supposed by some physiologists that each cell naturally secretes and re-absorbs individually, and it is only in a state of disease that a free communication and infiltration takes place. This variance in opinion seems to me to be decided by the fact, that in artificial, or accidental inflation, the air is readily re-absorbed without any ill effects; a circumstance which we could not suppose would take place under even slight laceration of parts.

The cellular membrane derives its arteries from the minutest branches, which, in most situations, seem only capable of circulating the colorless parts of the blood. This arterial distribution must not be confounded with the numerous branches which are transmitted and protected in their passage to other structures. The arteries themselves receive their vasa vasorum entirely from the vessels of the surrounding cellular membrane; hence an artery dies when deprived of its cellular covering.

Nerves, in a like manner, may be traced through cellular membrane, in their course to other structures; but it remains uncertain whether this tissue itself possesses any nerves; and we are led to this conclusion, as it does not manifest any sensibility, excepting in a state of inflammation, when the degree of sensibility may probably depend upon the tension produced by its swelling on the other parts in connection with it. This opinion is strengthened by the fact, that immediate ease is obtained by such surgical means as relieve pressure upon the part.

The chemical composition of the cellular membrane is difficult to trace, in consequence of its intermixture with blood-vessels, absorbents, and nerves. It consists principally of gelatine and mucus. By boiling, it by degrees will dissolve to gelatine; this is exemplified by the boiling of flesh, when the fibres of the muscle become separated into distinct fasciculi as the cellular membrane is dissolved.

The functions of the cellular membrane, independent of the support and free motion which it affords to the different structures of the body, consists of various secretions and absorptions. It is probable, that the insensible perspiration, at all times carried on, forms one of the principal excretories of its secretions; from which circumstance, there is a resemblance between the cellular and mucous membranes: but as absorption, as well as secretion, is constantly carried on, in that respect its functions resemble more those of serous membranes; hence there is a difficulty in assigning it to either class.

The secretion of serum in the living body, is in a state of vapour, or halitus, as may be seen on opening the body of an animal recently slain; this vapour quickly condenses on exposure to the atmosphere. The accumulation of this secretion, whether depending on the diminished action of the absorbents, or the excessive deposition from the arteries, produces anasarca; such collections are found most extensive in all situations where the cellular membrane is lax, and in abundance, particularly in the eyelids, prepuce, and scrotum; but where the cells are composed of dense and short fibres, they seldom or never fill, either in emphysema or anasarca. This is particularly the case in all the submucous and subserous cellular distributions; in the palms of the hands, and in the soles of the feet. And it may be further remarked, that in these situations, as well as around blood-vessels, the cellular membrane not only differs in the absence of serous infiltrations; but in the absence of adipose cellular membrane.

It appears that, during sleep, the secretion of serum is increased, as is seen by the moisture on the surface of the skin. The important function of decarbonizing the blood, may be thus effected when the lungs, and other vital organs, are in comparative quiescence.

The cellular tissue is one of the structures earliest developed; in the fœtus, it is at first abundant and in a semi-fluid palpy state; it then diminishes as the organs develope themselves, and at the same time as growth advances, its density increases. In the female it is more abundant and lax than in the male.

The cellular membrane has a greater power of reproduction, than almost any other structure in the body; and to it probably may be attributed the process of reparation of divided parts. The phenomena which occur in the union of divided cellular membrane when brought into immediate contact, consist, first, of the pouring out of a fluid, which soon has vessels shooting into it; and consolidating, the whole becomes highly vascular: this new structure remains for some time firmer, and more vascular, than the originally formed membrane; but, by degrees, it is not distinguishable from it. In large and extensive wounds, in which the edges are widely separated, a similar process occurs in the formation of granulations; and the readier process of growth in cellular membrane beyond that of the skin, is often witnessed in the exuberance of granulations before the new skin is capable of covering them.

The cellular membrane is frequently the seat of inflammation, which produces an adhesive deposit, and consequent consolidation, which diminishes the elasticity and power of motion in the part. Inflammation, in other instances, extends to suppuration; and in consequence of the slight degree of vitality of this structure, and the free communication of its cells, extensive abscesses follow, which are limited by a wall of adhesive inflammation, which sooner or later circumscribes the matter, according to the state of health of the individual.

When abscess is of slow formation, its cavity is sometimes lined with a membrane, presenting a secreting surface, connected to the surrounding parts by a compact cellular membrane; such is particularly the case in fistulas and sinuses—these are difficult to obliterate, until, by injection or division, a new character is given to their surfaces.

Inflammation of the cellular membrane sometimes terminates in the death of the part, when nature immediately endeavours to set up the process of separation; but, from the unyielding nature of the skin, this process is slow and tedious, and high constitutional irritation follows, generally accompanied with diminished power: such is the state in carbuncle, the means of treating which, consists in early crucial incisions through the skin, stimulating poultices, and every remedy which will hasten the separation of the dead part, and check the ill effects of constitutional irritation.

Elephantiasis, a disease common in the West Indies, has its seat in the cellular membrane, and is produced by the deposition of a gelatinous fluid into its cells, which increases the bulk of the diseased limb to an enormous size. It is not improbable, that this disease is owing to a specific inflammation depending on a derangement of the perspiratory function; the climates in which it is mostly found, are those which produce the most violent perspiration; and sudorifics, which tend to restore this function of the cellular membrane and the skin, are the remedies most beneficial in its treatment.

The importance of the function of this structure is proved by the remarkable manner in which it sympathises with the diseases of different, though distant organs; particularly those connected with respiration, and urinary secretion.

This is also witnessed by the great proportion of the chronic diseases of the heart, liver, and spleen, terminating in anasarcous effusions.

From accidental causes extravasation of blood sometimes takes place into the cellular membrane producing ecchymosis. Extravasation of other fluids may also occur; these fill the cells, in which they produce a greater or less degree of inflammation, depending on the quantity and quality of their nature; the most severe of which is from extravasation of urine.

Occasionally needles find their way into the cellular membrane, and traverse the body in a remarkable manner through its substance; they do not find their way from cell to cell, but are supposed to be moved by particular processes of inflammation,—ulcerative inflammation in front, suppurative on the surface in contact with the needle, and the adhesive behind.

Other foreign bodies, such as bullets, are occasionally lodged in the cellular membrane; when a membrane encloses them, which supports them in their situation, and prevents them from irritating the parts around. Should, however, inflammation be set up from any accidental cause, they will occasionally change their situation, or be thrown out from the body.

Adipose Membrane.

Is so called from the adeps, a peculiar substance it secretes. Whether this is a distinct membrane from the cellular, is a point by no means clearly ascertained by physiologists; the only grounds for such an hypothesis seem to arise from the peculiar form in which adeps is deposited, being invariably in grains, of a rounded or ovoid shape, attached at one extremity by a peduncle, supposed to be formed of its secreting vessels. It is questionable whether each granule is enclosed in a distinct envelope of membrane, which existed prior to the secretion of the fat; or whether it is derived from a secretion simultaneous with that of the adeps; and as it does not appear that any anatomist has been able to demonstrate this adipose membrane independent of the secretion of adeps, and as it is allowed by Béclard, Bichat, and others, that this structure is absorbed with its adipose contents: it is to me more than probable, that adeps is a peculiar granular secretion from the common cellular membrane. This structure is sufficient to account for the circumstance, that adeps does not infiltrate from one cell to another, although in a semifluid state. In every situation where adeps is found in the human body, it assumes aggregates of these minute globules, formed precisely according to the shape of the cells of the cellular membrane which encloses them; these masses are of various forms and sizes, depending upon the function and motion of the parts to which they are attached.

To suppose that adeps is secreted by a distinct membrane from the common cellular structure, involves the difficulty of demonstrating a second cellular, or adipose apparatus; which, from the variety of situations in which fat is found, would be almost as general as the distribution of the demonstrable cellular membrane; it is therefore more probable, that the cellular membrane appertains to the formation of fat, as well as the other structures of the body.

The existence of a distinct capsule to each granule of fat, is not equally demonstrable in every part of the body; and if we may suppose that the common secretion of the cellular membrane does surround each granule as it is formed, its fluid nature would tend alone to preserve the globular form of the oily secretion. On holding a piece of beef suet to a lighted candle, its surface will melt, and the granular structure immediately disappears; a circumstance which could hardly take place, if the capsule in every situation existed.

Malphigi tells us, that fat is formed of grains appended to the blood-vessels; Swammerdam, that it is a fluid oil contained in membranules. W. Hunter was the first to assert, that the cells containing fat do not communicate with each other in the same manner as those which contain serum. It is evident, that but little is known upon this subject; and wherever such is the case, each physiologist appears to indulge his imagination, under the assurance, that while nothing is certainly known, one conjecture has as fair a chance of belief as another.

Whether we consider the adipose membrane distinct or not from the cellular membrane, wherever fat is secreted blood-vessels may be easily injected. The terminations of absorbents in this structure, have not been demonstrated; but from the quick absorption of adeps, under various circumstances, their existence cannot be doubted.

The evidence of the existence of nerves in the adeps, is also a matter of doubt.

Adeps is secreted in different parts of the body; it is found abundant under the skin; a mass of fat is situated in the orbit, and between the muscles of the cheeks; the back of the neck contains a greater quantity than its front part; both the external and internal surfaces of the chest are furnished with fat, as may be seen around the heart, between the pectoral muscles, and around the mammæ. In the abdomen, it is seated around the kidnies; in the substance of the mesentery, and omenta, within the pelvis; and around the pubes. On the extremities this tissue is abundant, in the bending of the joints, and in those parts subjected to pressure, as on the buttocks, and soles of the feet.

The accumulation of adeps, takes place in different parts of the body at various periods of life. In the fœtus, after the fourth month of uterine gestation, it begins to accumulate under the skin, where it is deposited in minute rounded masses; and is then absent from nearly all those parts where it is accumulated at the adult period. In the adult, it is found in the abdomen, around the kidneys, mesentery, and omentum.

In old age, this substance is nearly absorbed, leaving first the external surface of the body; but still remains around the viscera of the abdomen, around the heart, in the cavities of the bones, and substance of the muscles.

There are certain situations in the body in which fat is never secreted, as under the scalp, eyelids, nose, ear, scrotum, prepuce, nymphæ; on the external surface of the body, and internally in the substance of the uterus, liver, spleen, and between the coats of the stomach, and intestines.

The secretion of adeps is of considerable importance in the animal economy; it may be said to form a source of nutrition when the stomach and intestines are deranged in their natural functions; it forms a protection against the effects of cold, particularly in children, who, possessing such a clothing of subcutaneous fat, are liable to resist the effects of cold in a remarkable manner; while, on the contrary, those who are emaciated, from protracted disease or from age, are painfully sensible to the vicissitudes of temperature. It may be observed, that the secretion of adeps is more abundant towards winter; and this is particularly observable in certain birds, quadrupeds, and hybernating animals.

Fat, in its formation, answers a most essential purpose, not only as a source of nutrition, but for the office which it performs in disposing of a considerable quantity of carbon, which materially contributes to the purifying of the blood; hence it is that we see persons, who are confined in unhealthy situations and impure air, frequently become loaded with unhealthy fat.

The quantity of fat in a healthy adult, amounts to one twentieth part of the weight of the whole body; but, at times and from causes not understood, it will accumulate even to the surprising quantity of four-fifths of the weight of the body.

The circumstances which tend to an accumulation of fat, are indolence of habit, rest of body, and ease of mind. Castration, also, increases the growth of fat; probably from the diminished excitability of animals under such circumstances.

It is remarkable, that great growth of fat in the female obstructs the generative powers; this is observed in domestic fowls, which, in proportion as they are fattened, are less capable of laying eggs.

The circumstances which diminish the tendency to the formation of fat, are violent exercise, great activity of mind and body, abstinence, and increased perspiration. A diseased state of the vital organs, and more especially those of digestion, occasions a rapid absorption of fat.

There are sometimes partial accumulations of fat, forming very large tumours, in various situations of the body, but most commonly under the skin; these are termed steatometa; they are generally of a rounded form, communicate a doughy feel to the touch, and are perfectly free from pain, producing no other inconvenience than from their weight. Such tumours are sometimes placed between the peritoneum and abdominal muscles, where they are of more importance, from their pressure on the viscera. They are enclosed by a cellulous envelope, occasionally of considerable thickness, and containing blood-vessels, which are in proportion to the size of the tumour; although at the same time these tumours have fewer and smaller vessels than any other.

The adeps contained in these tumours appears the same in every respect as healthy fat in other parts of the body, unless it be found somewhat more consolidated from pressure. In old persons, the muscles are occasionally filled with fat, and are of a white colour; whence has arisen the supposition, that they have changed into fat: but this is never the case, as the fibrous structure of the muscle, although altered in appearance, always remains.

In local inflammation, where the adipose tissue is most abundant, gangrene frequently occurs, from the little vitality of this structure; this is frequently seen in large umbilical herniæ, where portions of fat omentum are left in the sac, when it is found readily to sphacelate; and a considerable quantity of adeps escapes in a fluid state, leaving the membrane behind, which is slower in its ulcerative process of separation; but sometimes remains as an organized part within the sac.

Adeps is found in various parts of the body, forming morbid affections; these occur in the ovaria, and form encysted tumours in the neighbourhood of serous membranes.

The medullary substance of the cavities of the bones, which so much resembles the adeps, both in its composition and in the cellular membrane which encloses it,—has been noticed, when treating of osteology.

LECTURE XXI.

GENERAL ANATOMY OF THE SKIN OR COMMON INTEGUMENTS.

Under this title, we shall consider those integuments which form the exterior covering of the body; and although many anatomists and physiologists have classed the mucous membranes as a continuation of the same structure; their variety of function is so great, that the mere circumstance of the imperceptible blending of the one into the other, is hardly sufficient to identify them as being the same. On the contrary, there is a marked difference both in the physical and vital properties, between a surface destined to be in contact with atmospheric air, and a surface lubricated by mucus, which enables them to bear the contact of fluids, and stimulants of various descriptions. The line of demarkation between the tegumentory coverings of the exterior and interior of the body, is sufficiently obvious; as in the eyes, nose, lips, anus, and in those situations where mucous secretions commence; although the cuticle, or external layer of the skin, does proceed and may be traced into the interior of some of those cavities which are exposed to a variety of stimulants, as in the alimentary canal. It is further distinguished from the mucous membranes by containing fewer blood-vessels, and by being more dense.

The skin is the strong elastic external covering of the body, formed both to afford support, and to allow of the free motions of its several parts. It is found to cover the whole of the external surface of the body, but presents varieties of structure in different situations; on the posterior surface of the body, it is thicker than on the anterior, and on the external surface of the limbs than on the internal; and more particularly where subjected to pressure, its thickness will be considerably increased, as on the palms of the hands, and soles of the feet. The skin is connected with the parts underneath by means of cellular membrane, which is more or less abundant according to the extent of motion the subjacent parts are liable to. In this attachment, the skin of the body presents a mezian division by a line of closer and firmer texture, which extends along an imaginary vertical line, dividing the trunk into symmetrical halves; but which line, externally, is interrupted by the natural outlets of the body; although in fact, as has been mentioned, it passes into these orifices to be connected with the mucous membranes.

To the elasticity of the skin we are indebted, in a great measure, for the symmetry and form of the body; were it not for this physical property, in every distortion, the skin would require some new vital action to restore it to its natural situation. In the extensive motions of the various joints of the body, the skin arranges itself into numerous wrinkles, corresponding precisely with the centre of motion of each joint; and where the skin is under the influence of muscles, the wrinkles will correspond with the direction of their contractions, as may be seen particularly on the forehead, eyelids, neck, and other parts of the body. These wrinkles must not, however, be confounded with those of old age, which depend upon the general shrinking of the whole fabric.

The surface of the skin presents numerous minute openings, of a rounded shape, which are the excretories of the sebaceous follicles; these are very generally distributed, but are most abundant on the nose and face: there are also smaller openings, which are scarcely perceptible without the assistance of a microscope; these are the perspiratory pores: the skin is also penetrated by the hairs which pass through its substance. The color of the skin varies in different parts of the body; it is darker on the scrotum, perineum, upper part of the inside of the thighs, and in the axilla; probably depending on the secretions of these parts to defend them from friction. Its colour also varies from the influx of blood into its vessels; this is particularly obvious about the face and neck, as is evinced by blushing, and the various tints produced by morbid affections. There are still further varieties of colour, characteristic of the different races of mankind: these varieties are white, in the European; black, in the African Negro: and there are intermediate shades, as copper-colour, tawny, &c.: in these varieties, the colour of the hair generally corresponds with that of the skin.

A vast variety of hypotheses have been advanced respecting the structure of the skin; on the most minute examination, it is divisible into three distinct structures,—the cutis, rete mucosum, and cuticle; each of which we shall describe separately.

The Cutis.

The cutis is placed between the rete mucosum, which is on its external, and the cellular membrane, which is attached to its internal surface; its external surface presents a white mass, of a uniform dense consistence, composed of numerous fibres, crossing each other in every possible direction so as to form a compact solid substance; this compact texture of fibres, which has not inaptly been compared to felt, becomes looser on its internal surface, where the fibres are longer; and beginning to form cells, gradually enlarge until they are blended and confounded with the cellular membrane. On the quantity and density of this compact structure, depends the degree of strength, elasticity, and various thicknesses of the skin in man, and other animals. This structure of the cutis may readily be examined in any one of the different species of tanned leather in common use. (*Vide Plate* II. *Fig.* 7.)

The external surface of the cutis presents innumerable minute sulci, or fossæ, which cross each other in a variety of directions, giving it a net-like appearance of uneven meshes; these sulci generally assume a direction corresponding to the habitual motion of individual parts. Between these sulci or fossæ the surface of the cutis projects in corresponding eminences, which are again subdivided by minuter eminences, of a somewhat vermicular character, on the general surface of the body (*Vide Plate* II. *Fig.* 3.), but arranged in parallel structures on the palms of the hands, and soles of the feet; and more particularly apparent on the extremities of the fingers and toes. (*Vide Plate* II. *Fig.* 1 *and* 4.)

These minuter divisions are, perhaps, the true papillæ of the skin, and the particular surface in which the sense of touch resides, and through which the perspirable pores pass; they are found particularly sensible at the extremities of the fingers and toes; in the former of which they are rendered more sensible, as organs of touch, from their habitual use; they are also exquisitely sensible on the lips, where they are arranged in such a manner that their apices are directed forwards; so that when the lip is drawn backwards, the sensation is increased by a larger surface of each papilla being exposed to contact. A similar arrangement of the papillæ is found in the skin of the glans penis, where they are all turned towards the extremity of the urethra; so that when the prepuce is drawn backwards, the papillæ are subjected to friction, and their sensibility increased. The papillæ over the whole surface of the body possess a similar sense of touch, but differing in degree, according to the frequency of exertion; we have more or less a proof of this supposition from the circumstance, that exquisite sensibility may be acquired in different parts of the body under habitual exertion, when the upper extremities are disabled.

The skin, besides this organization, possesses secreting structures of three kinds:—

First, the perspiratory pores; these are situated by the sides of the papillæ, and may be seen with the assistance of a common lens, having the appearance as if the cutis had been punctured with a needle; through which openings the perspiration may be seen to collect in minute globules.

Secondly; there are follicles, which are openings communicating with minute cavities under the cutis, which secrete a sebacious oily matter. The use of this secretion seems to be for the purpose of lubricating the surface of the skin, and of defending it from the vicissitudes of temperature.

Thirdly; in some parts of the body there are little glandular structures found underneath the skin, which are termed miliary glands; they are abundant in the axilla, and on the prepuce; they are for the purpose of defending the skin, by an oily secretion, from the effects of perspiration. This secretion is of a peculiar fœtid smell, particularly in those who are not cleanly in their persons.

The cutis is a highly organized substance; its *arteries* are extremely minute and numerous, as may be seen in successful injections; their principal accumulation is on its external surface, where they are seen to intersect and anastamose with each other in a great variety of directions; in some instances, apparently taking the form of the meshes; in others, terminating in minute bundles, which present distinct spots of congregated vessels. I have great reason to think, that many of the beautiful injected preparations of the skin at the College of Surgeons, and other museums, are in some instances successful, not only in the true skin, but in the rete mucosum on its surface; in the latter of which the above-mentioned appearance is always more or less apparent.

The *veins* of the cutis are also exceedingly numerous, and are larger than the arteries, take a similar mesh-like direction, and probably terminate in a peculiar structure immediately underneath the cuticle; being furnished with valves, they are much more difficult to inject than the arteries, but have occasionally been so demonstrated on the prepuce.

The *absorbents* on the surface of the cutis, are not easily demonstrated; although in the cellular membrane immediately underneath, they are numerous, large, and easily injected.

The *nerves* are numerous, and are distributed to the cutis in abundance, communicating great sensibility, so as to produce most painful sensations in cutting the cutis, or exposing it by abrasion of the cuticle.

The distribution of the nerves in the cutis is of great importance in the animal economy, as forming the seat of the sense of touch; very little is known of the real nature of this function, beyond its connection with the vital principle. It has been stated by physiologists, that each of the papillæ consists of a spongy elevation of the cutis, into which projects the soft and sentient extremity of a nerve enclosed in some erectile tissue; these, however, are only assertions, unsupported by any anatomical demonstration. Contact appears to be necessary to the production of the sense of touch, but to what extent the cuticle is connected with the sentient extremities of the papillæ is unknown; and whether it admits of the papillæ being projected through corresponding openings, to form a contact to produce the sensation of touch, is also unknown. The ready manner in which the mind distinguishes the different forms and consistencies of bodies through the medium of the sense of touch, proves the efficiency of this apparatus of nervous distribution to be very different from the distribution of those nerves which only experience painful sensation from their contact with foreign bodies.

In some animals, the surface of the cutis presents a curious structure of papillæ, which coat it externally; they are of a whitish appearance, broad at their base, terminating in minute points, which appear to project into the substance of the cuticle, and would give one the idea, that if the sense of touch resides in these papillæ, that a similar structure may exist in the human subject, although too minute to be demonstrated. This structure is beautifully seen in different preparations of the common integuments of the whale tribe, in the Museum of the Royal College of Surgeons.

The Rete Mucosum

Is situated immediately on the surface of the cutis, between it and the cuticle. The difficulty which attends the dissection and demonstration of this membrane, has given rise to various conjectures respecting its nature and particular structure. Hence the great variety of opinions between those physiologists who describe the rete mucosum as being composed of three distinct layers; while there are others of equal eminence, who deny its existence altogether. According to the result of my own investigation, the following structure appears to be demonstrable.—To shew the rete mucosum, a piece of healthy black skin, just removed from the body after an operation, should be immersed in boiling hot water, and then thrown into alcohol. The cuticle may now be carefully pealed off, leaving the rete mucosum on the surface of the cutis; and when this has been done, its structure is visible (*Vide Plate* II. *Fig.* 8.), and appears to be composed of a net-work of veins, assuming a peculiar inosculation, differing from that of arteries. It is characterized by frequent, short, anastamosing branches, uniting nearly at right angles, or rather forming figures in which right angles predominate; while, on the contrary, arterial inosculations form figures, in which acute angles predominate; and these are seen, in the minute injections of the arterial distribution, on the surface of the cutis. (*Vide Plate* II. *Fig.* 9.) The venous structure is situated immediately underneath the cuticle, and exterior to the minute arterial distribution on the surface of the cutis; and appears to be the true seat of colour of the skin. There are two preparations in which this structure is very successfully demonstrated; the one may be seen in the Museum of the College of Surgeons, and the other at Guy's Hospital; the representation, Plate II. Fig. 8, is taken from the latter, magnified in the proportion of one inch to one-eighth of an inch.

This structure appears to be much thicker in the Negro than in the European, and the vessels themselves much larger. In the preparation above alluded to, in the College of Surgeons, it is so thick at one portion, as very much to resemble the rete mucosum of the cetacei.

There is considerable difficulty in separating the cuticle from the rete mucosum, in consequence of its firm adhesion ; and in those preparations which are even most successful, portions of it will be seen adhering to the raised cuticle. The process of putrefaction seems to go on more readily in this structure than either in the cuticle or cutis, which occasions the ready separation of the cuticle, and probably explains the reason why, in this separation, the rete mucosum is not discernable, but merely a mucous deposit adhering both to the surface of the cutis and cuticle. These surfaces have, therefore, been described as separate layers ; while the colouring matter, which is well known to exist, has been assigned to the space between them ; thus giving rise to the supposition, that rete mucosum is formed of three separate layers of membrane.

As the seat of colour, the rete mucosum has an undeniable existence ; and it is clear, that the cuticle possesses a semi-transparency, through which this colour is more or less discernable. The black colour of Negroes depends on the black colour of the rete mucosum, seen through the cuticle ; in Europeans, also, various shades of colour are found, generally according with the colour of the hair, and eyes ; these various shades may be observed in the different gradations between a fair and brunette's complexion ; the former, generally with light blue ; the latter, with dark eyes, and jet black hair. It is generally said, that the rete mucosum is wanting in the Albino, and in white animals of other species. It does not however, accord with the usual operations of nature, to have any structure entirely wanting : it may exist in a colourless state, and in a very small quantity ; still smaller than in the European, where it is evidently less than in the Negro.

Five principal shades have been enumerated as characteristic of the several races of mankind. In the Caucasian, white ; in the Mongolian, yellow ; in the Æthiopian, jet black ; in the American, copper colour ; in the Malayan, tawny, or resembling dark mahogany.

The Epidermis, or Cuticle,

Forms the external surface of the skin; it is a semi-transparent insensible membrane, and seems destined principally for the purpose of protecting the more sentient parts underneath from the action of the air.

A vast variety of hypotheses have been formed respecting the structure of the cuticle; but upon minute examination, the following appearances present themselves. It every where partakes of the true form of the skin underneath, dipping into its interstices and minute fossæ, in precise conformity with the fossæ and wrinkles which are adapted to the mobility of the skin.

In a like manner to the cutis, the cuticle differs in its thickness and structure in different parts of the body. In the soles of the feet, and in the palms of the hands it is arranged in rugæ parallel to each other, and which take various directions according to the form of each part; on the tips of the fingers and toes, the rugæ are nearly parallel with the convexity of the termination of the nails, taking the circular direction of the ends of the fingers; by this arrangement, a centre of circles is produced nearly opposite to the roots of the nails, having one or two perfectly concentric turns; after which, they incline towards the sides of the fingers: below these concentric turns, the rugæ are again nearly parallel with the joint of the phalanges, while in the palms of the hands they assume various directions. The rugæ are studded at various distances on their projecting surfaces with perspirable pores. (*Vide Plate* II. *Fig.* 1.) On the tips of the fingers, where the sense of touch particularly resides, small projecting papillæ are frequently seen between the rugæ, being about one third of their breadth, and on which no pores are perceptible: whether these shield the sentient extremities of the nerves of the sense of touch in any particular manner, is a mere subject of conjecture; but they are not met with in any other situation. (*Vide Plate* II. *Fig.* 4.)

The appearance of the cuticle on the backs of the fingers, is very different from that above described; the rugæ, instead of being disposed in parallel directions, are broken into innumerable small portions, the surfaces of which have a vermicular appearance, variously contorted. On the back of the hand, the arrangement of the rugæ is not so distinct, being crossed by innumerable wrinkles adapted to the elasticity of the skin; which rugæ, meeting in various directions, divide the surface into minute angular portions. By a microscopic examination, the same structure, as described above, appears to appertain to the skin generally, but is rendered less apparent by the cuticle being more loose on those parts which have most motion. It is apparent on the backs of the fingers, and more especially over the joints of the phalanges. The manner in which the papillæ are arranged in the diamond-shape on the back of the hand, is represented in the proportion of one inch to one-eighth of an inch in *Plate* II. *Fig.* 2; but not being sufficiently distinct, it is enlarged in *Fig.* 5.

In the formation of new cuticle, we may gain a very fair idea of its structure, and original growth; at the same time proving that it is not, as is described by Leuwenhoeck, formed in scales. A thin transparent layer is first perceived, which becomes thickened by a succeeding layer formed underneath it; these layers continue to be deposited upon the surface of the rete mucosum, until they have acquired a thickness corresponding to the pressure to which each part of the body is subjected. From this structure it results, that the under surface of the cuticle, however thick the cuticle may be, exactly corresponds in structure with the external surface. This conformation is evinced by those preparations of thickened cuticle taken from the heel, or any other part of the body exposed to great pressure. In these may be observed, on the under surface, furrows or depressions, corresponding with the elevated rugæ on the upper; and the perspiratory pores may be more distinctly seen from the processes of the cuticle, which pass with them into the cutis.

(*Vide Plate* II. *Fig.* 6.) In the cut edges of these thickened portions of cuticle, the perspiratory pores may be seen to take a perpendicular direction through its substance; which circumstance further proves, that the layers of cuticle are not deposited in scales.

No blood-vessels, nerves, or absorbents have been traced to the cuticle ; hence it has been considered as an inorganized substance : but the vitality it possesses is apparent, from the important functions it assists in, from its growth, and from its death and separation when injured, like other structures in the body. In fact, it is difficult to believe that any part can be inorganized as long as it performs the functions for which it was constructed. To this vitality we may refer the remarkable property of the cuticle which it possesses, of allowing the exhalents to transpire various fluids through its pores; which property is immediately suspended when the cuticle is raised from the surface of the skin underneath. The serum of a blister is confined by the cuticle, notwithstanding considerable pressure, as in blisters of the feet from walking. Physiologists have assigned various reasons for this phenomenon; namely, that the cuticle, when detached, breaks away portions of the cutis, which close its pores ; again, that the cuticle, being elastic, closes its pores by contraction in its detached state; and further, that the pores, passing in an oblique direction, are thereby closed by the distention of the blister: actual examination does not corroborate either of these conjectures ; the pores of the raised cuticle do not appear to be closed by detached portions, nor does the surface of the cutis exhibit any such lacerations; the cuticle is by no means so elastic as the cutis, and its pores pass in a perpendicular direction. One fact is worth a thousand conjectures: the cuticle, when detached by a blister, loses its vitality, and with it the power of function.

The skin, independent of its forming a suitable covering to the body, has important functions to perform, intimately connected with the animal economy. Its function as an organ of touch, we have already partly considered with the structure particularly destined for this sensation; we may, however, further remark, that although this sense has a greater power in particular situations, its general distribution in every part of the skin, is of the utmost importance as a source of protection, by the information which it communicates in cases of danger: this is evinced by the sudden and universal sensation occasioned by the slightest touch of such objects as, from their nature, are considered hurtful to the human body. Morbid sensibility of touch, in some individuals, exists to a very great extent upon the contact of certain objects, which are to others perfectly innoxious; such I have known to be the case in a sensation communicated from the skin of the cat, of a peach, and the leaves of such plants as have minute hairs.

The principal function of the skin, is the important secretion of perspiration, which, in a healthy individual, is constantly going on insensibly, in a state of vapour; but when this secretion is accelerated by violent muscular exertion, accompanied by quickened respiration, the perspiration is poured out in the visible form of sweat. This answers a very important purpose, by preserving the temperature of the body, which otherwise would be so greatly increased by muscular exertion, as to produce the most painful effects. The great power which the perspiration has in reducing the temperature of the body, is witnessed by the high degree of heat which glass-blowers, and men in iron foundries, are capable of sustaining; and in all such instances, perspiration flows in streams from the surface of the skin. Dr. Fordyce, and Dr. Blagden, made experiments to ascertain what was the degree of heat the body was capable of bearing; in these experiments, it was found that, in a room heated to the temperature of 264° of Farenheit's thermometer, respiration could be carried on without any particular distress after perspiration had broken out upon the skin.

In these experiments, we must remark the effect produced by perspiration in preventing the increase of the heat of the body beyond that point which would prove injurious. At the time the temperature of the room was raised to 264°, the heat of the body itself never rose above 102°—its natural temperature being 98°; which, in fever, is rarely or never raised above 101°. This vital regulation of temperature resident in the skin, in some instances would appear not exactly to depend upon the mere process of evaporation producing cold, as frogs and fish are capable of maintaining a standard temperature of body in water of a much higher temperature.

Occasionally in fevers this function of the skin seems to be suspended, particularly in fevers of a typhoid character; when the great heat of the skin will communicate to the touch of a healthy person the sensation of a burning surface; in such instances, relief can only be obtained by the application of artificial cold and moisture; and nothing can exceed the pleasurable feelings of persons thus relieved from the insupportable heat of the body.

The quantity of perspirable fluid secreted from the skin of a healthy subject in a given time, under the different states of rest and exertion, has been the subject of various experiments, by different physiologists. Mr. Cruikshanks placed his arm in a glass vessel, and found that, in the space of one hour, twenty grains of perspiration were given off; he repeated the experiment, but now walking about, and in one hour forty-eight grains were produced from exertion; thus making the difference of rather more than one half. Mr. Allen tried this experiment, subjecting a glass tube in which his arm was enclosed, to a high degree of heat; when the perspiration became excessively profuse.

Another important function is referable to the skin, wherein it answers a somewhat similar purpose to respiration; and, like it, appears to assist in decarbonizing the blood. This is found by the precipitation of a carbonate of lime, when the hand, in a state of perspiration is immersed in lime water; or if the lime water is exposed to air which has been for a length of time confined upon a surface of skin. These are similar results to those produced by subjecting lime water to the action of expired air. May not this decarbonizing function principally depend upon the venous structure which characterizes the rete mucosum immediately under the cuticle? As in the lungs, we find the veins bringing the blood to be exposed to the air within its cells, so in this venous distribution, it is exposed to the action of the air on the surface of the body. The parts are too minute to demonstrate the particular mode of the contact and connection between the venous distribution and the air; but this structure of veins, and the known function which is performed by the skin, have so strong an analogy with respiration, that I cannot help throwing out the conjecture of their identity.

The chemical analysis of perspiration shews, that it has various compounds; Dr. Anselmino, according to Richerand, states it to consist of—

Calcareous salts - - - - - - -	0	02
Animal matter with the sulphate	0	21
Osmazone and chlorurets of soda and of lime - - - - - - -	0	48
Osmozone combined with the acetates and free acetic acid	0	29
	0	100

The skin also secretes an oily matter, which may possibly be an exudation of the subcutaneous fat, as it is found most abundant in corpulent people; it is of a greasy nature, burns with a white flame, and leaves a carbonaceous residuum; it appears to serve the purpose of protecting the cuticle from the effects of the more fluid exudations of perspiration, as well as the moisture of the atmosphere; to this secretion is owing an effect seen in bathing, when the water may be observed to hang in drops upon the surface of the skin of the back, and to trickle off in parts without leaving the skin wetted.

There is, further, a secretion from the sebaceous follicles, of a thicker consistency, and more of a ceruminous nature, which appears also to be for the purpose of protecting the skin from the irritation of its own accumulated secretions.

From the foregoing considerations of the many important functions performed by the skin in its various secretions, we have a strong proof of the necessity both of air and exercise to maintain the healthy state of the body; and for the same reason, indolence of habit, and the various indulgences which luxury resorts to, are so many means which contribute to an unhealthy state of the system. This is proved by the sympathy which exists between the functions of the skin, and those of other parts: and such a reciprocity of action takes place between them, that the health of one depends upon the natural action of the others.

Considerable doubts have been entertained respecting the absorbent power of the skin; it has however been pretty clearly proved, that, although incapable of absorbing fluids, gazeous substances may by this process be taken into the system. The fact of chlorine depriving the rete mucosum of colour in the Negro, proves the existence of cutaneous absorption. Sir Astley Cooper, who has paid much attention to this subject, seems inclined to believe that the cuticle offers a strong resistance to absorption; and that unless it is abraded, by friction or otherwise, cutaneous absorption does not take place. Those who are of a different opinion, instance the urine becoming tainted when the hand has been immersed in turpentine; but by numerous experiments, it has been proved, that this effect does not take place, unless the vapour arising from the turpentine has, at the same time, been inspired: and again, that persons jumping into cold water in a state of extreme thirst; being relieved from this situation, is not to be considered as depending upon the absorption of the fluid, but upon the effect of cold; which, under all circumstances, lessens the sensation of thirst.

The development of the skin commences at a very early period after conception; in the embryo, it is first discoverable about the fifth month, when it is of a rosy tint; the sebaceous follicles make their appearance about the same time, and are seen, first about the head and face, and then in other parts of the body. About the seventh month, the skin is covered with a sebaceous secretion, which remains until the time of birth. In new-born children of Negroes, the skin is of a redder appearance than in Europeans; the black colour begins to shew itself the moment the child respires, but is more particularly apparent towards the third day after birth; first around the nails, nipples, organs of generation, anus, and eyes; about the seventh day, the colour becomes general. It may be here remarked, in addition to what has already been said on the subject, that the rete mucosum has an intimate connection with respiration.

The diseases of the skin, as might be supposed from the variety of functions which it performs, are very numerous, and seem principally to depend upon those causes which diminish the quantity and quality of its secretions: hence it is, that we find persons who take but little exercise, and consequently perspire but little, are the most liable to cutaneous eruptions. These diseases put on various appearances, and are accompanied with such different symptoms, that those who have made them a subject of particular interest and study, have divided them into many orders, species, and varieties, which form a lengthened and intricate nomenclature.

In injury to the cutis from mechanical lesion, there is a power of reproduction resident in the vessels of the skin; and if the division has occurred from a cutting instrument, and the parts be brought in contact with each other, a union quickly occurs, which is termed adhesion by the first intention; a small cicatrix is formed by the deposition of coagulable lymph; and then the cuticle is quickly formed over it; gradually acquiring all the physical properties of the old skin.

When the wound is extensive, the power of reparation is slower, and a better opportunity is afforded to watch the phenomena as they proceed; they will be found to occur in the following order: first, the deposition of an agglutinous fluid, probably only the serum of the blood over the whole surface of the wound, being apparently inorganised; secondly, it shews signs of organization in the formation of circular granulations, which secrete more or less pus, and becoming gradually contracted on their surfaces, put on the appearance of a mucous membrane; when, lastly, cuticle is secreted, and cicatrization completed. When this process is first completed, the new-formed skin does not possess the same properties as the old skin, being less elastic, of a more opaque colour, and through life remains more liable to ulceration. This is the case with respect to the new formation of every structure in the body, as well as that of the skin; for it has been found in bad cases of scurvy produced by long voyages, that not only old cicatrices have re-opened by the ulcerative process; but that united fractures of long standing have also become again separated. This tendency to ulceration, depends apparently upon newly-secreted structures never becoming so vascular as when originally formed.

It is believed by some and denied by others, that the rete mucosum is regenerated in cicatrices; Camper is of opinion, that it is not, and instances it by the assertion, that cicatrices in Negroes remain of a white colour; this is not admitted as a fact by others; who assert that it is only an alteration in the degree of colour, and producing therefore only a different shade; which may arise from the new rete mucosum, like the cutis, being less vascular.

There are various opinions with respect to the formation of new skin; whether or not the vessels from granulations are capable of producing it; or whether it can only be formed from the vessels of the old skin: and it is usually believed, that portions of new skin, which are frequently formed in the middle of old ulcers, are never generated into cicatrix, but become absorbed; and that the formation of the cicatrix must take place from the circumference of the sore, and from the edges of the old skin. As far as I have observed, this depends upon the depth more than the extent of surface in the wound; for if the cellular membrane is left, or regenerated, so as to cover the muscles and subjacent structures, then new skin can form on any part of the wound, although it will always generate quicker at the edges of the old skin; hence the use of approximating them during the healing of a large ulcer.

Bandaging also assists in the reproduction of skin, by subjecting the cellular membrane to its natural pressure.

The similarity of structure between the cutis and the mucous membranes, is rendered very obvious, both in disease and in reproduction. As has been remarked, newly-formed cutis, just before it becomes covered by the cuticle, has all the appearance of mucous membrane; and mucous membranes themselves, when exposed to the atmosphere, and being no longer capable of performing their natural functions, become covered with cuticle; this I have frequently seen in prolapsus ani: and Dr. Blundell told me of a case of procedentia vaginæ, where the protruded mucous membrane was not only covered with cuticle; but that a rete mucosum was also found, giving to the part the colour of the skin of the scrotum and prepuce. In extensive burns, also, where a diseased action is set up, and cuticle is not reproduced, the cutis not only has the appearance, but also more or less the function of mucous membranes, lubricating its surface with a muco purulent secretion.

The skin is also the original seat of disease, arising from the obliteration of the excretory canal of the sebaceous follicles; from which circumstance, accumulations of the secretion will frequently occur, forming what are termed, when they acquire large size, an encysted tumour: not that I believe encysted tumours are always so produced; for, in some instances, the cyst as well as the secretion seems entirely adventitious. In these follicular tumours, when small, the secretion may usually be pressed out of the duct, the situation of its opening being apparent, from a little dark spot produced by the exposure of its secretion to the air: and when they have acquired even the size of a walnut, the duct may generally be discovered, and a probe pushed into the sac; after which it may be emptied of its contents: but when they are very large, it is necessary to remove the sac, to ensure a radical cure.

The varieties of colour of the skin may, perhaps, be considered entirely to depend upon the development and function of the rete mucosum; and there seems to be no circumstance which tends more to strengthen this supposition, than the facts connected with that peculiarity of colour constituting what is termed the Albino. In them the colour is a dull reddish white, the hair nearly colourless, and the eye red; these appearances are supposed by some physiologists to depend upon the absence of the rete mucosum, and pigmentum nigrum of the choroid coat of the eye. Whether this state is to be considered as disease, or malformation at birth, is yet a matter of doubt; the regularity of the other functions of the body, notwithstanding the greater susceptibility of the eye to light, and the diminished power of function in the skin, shews rather that this peculiarity is not depending on disease.

This peculiarity is a variety which occurs among all races of mankind, and appears to be the same in white rabbits, and many other animals.

There are certain spots which occasionally occur in the skin, on different parts of the body, which, upon dissection, shew a darker structure of rete mucosum. I am inclined to consider those patches which are termed aneurisms by anastamoses, as depending upon a varicose state of the vessels of the rete mucosum; particularly from the ready manner in which they are fed from neighbouring vessels, as it were from a net-work, and which cannot be cured without the total eradication of the whole mass.

Some of the appearances in melanosis, also lead me to suspect, that they have some reference to a diseased function in the rete mucosum.

The cuticle appears to be variously diseased, and different views have been formed by those who consider it as merely a secretion from the skin, and those who believe it to possess an independent organization. As a covering to the body, its principal office seems to be, to defend the more sensitive integuments underneath from the action of the atmosphere; hence the great suffering which is produced merely by the loss of a small portion of this protecting medium; and the cause of death in extensive scalds, and burns, appears generally to depend upon the irritation of the air upon the exposed surface, which produces such violent effects, that the constitution sinks under it. The peculiar power which the cuticle possesses in resisting the drying effects of the atmosphere upon the cutis, exists for a considerable length of time, even after death. I placed a piece of skin in the sun, one half of which was denuded of its cuticle, and which dried up into a kind of horny substance, in the course of a few hours; while the other portion, from which the cuticle was not removed, remained for three weeks very little altered, the cutis remaining underneath in its natural, soft, and pliant state.

The cuticle, the hairs, and the nails, appear to possess a remarkable variety from all other living structures, in not being absorbed after formation. Nature appears to have provided for this by the constant desquamation of their exuberant growths; with respect to the cuticle, in the human subject, this may be readily seen, in those parts where it accumulates in the greatest quantity, as in the scalp, feet, palms of the hands, and other parts of the body, from whence it is abundantly detached by friction, and more particularly when separated by warmth and moisture; and in reference to the hair and nails, from the constant necessity of keeping them short by cutting. This separation of cuticle in many reptiles takes place at stated periods, by a general removal from the whole surface; and it is remarkable, that, in such instances, the cuticle is detached from the surface of the eye, shewing its transparent formation over that delicate organ; which fact offers an objection to those theorists who assert, the cuticle to be a mere secretion from the cutis.

The cuticle, in some serpents, is separated from their bodies as often as once in two months; while in other animals, as in the crustacea, and certain insects, it appears to occur but once in a year; during which time, the torpid state tends to diminish their respiratory function until the new cuticle is devoloped.

The cuticle has a remarkable power of reproduction, as may be seen from the quick manner in which it is capable of furnishing a new covering over denuded surfaces.

Pressure has an effect in producing the growth of cuticle, as is seen by its great thickness in the palms of the hands, and soles of the feet; but in certain instances, from malformation of the feet, pressure will be thrown in an undue proportion on certain parts: this occasions so great an increase of cuticle, as to amount to a disease on that part, and can only be relieved by the removal of the whole surface of the thickened cuticle, by repeated applications of blisters; and when this has been accomplished, it is necessary to protect the denuded part from pressure, by mechanical means, for a considerable length of time, otherwise the superabundant and hardened cuticle will re-form with great rapidity.

Corns are of a similar nature, and the tendency to their formation, and their growth, is in a like manner owing to pressure; the method used by Chiropodists to extirpate them is, first to soften the skin by immersion in warm water, then with a blunt knife to detach and raise the cuticle a little distance from the circumference of the corn; which operation, being continued, the corn is gradually separated.

A hardened prolongation of a substance of the nature of cuticle, will sometimes grow from the skin, and most frequently from the scalp; they have been termed horns, but appear to depend upon an accumulated secretion from the surface of an ulcerated sebaceous follicle, and not, as has been supposed, from a morbid secretion of cuticle: these sometimes acquire a considerable size, and curl round in resemblance of a ram's horn. They are easily removed, but are usually supplied with a blood-vessel of a considerable size.

ANATOMY OF HAIRS.

The hairs and nails are termed the appendages of the skin; the former, however, do not arise immediately from the skin, but from the cellular membrane beneath it; projecting more or less beyond the inner surface of the cutis, according to their size and stiffness.

The structure of a hair is as follows:—It is formed of a cylindrical tube, of a horny consistence, pointed at its free extremity, and terminating in a soft bulbous enlargement at its attachment, containing a gelatinous lymph. This bulbous enlargement is of a lighter colour than the lengthened tube which proceeds from it, and has a perforation rather to one side of the bulbous extremity, where it is soft and pulpy, and encloses the vessels which communicate with the membrane that lines the interior of the tube. From this membrane, and more particularly that part within the bulb, an oleaginous fluid is secreted, which communicates colour to the hair; being of different shades, from a transparent white to a jet black tint.

The bulbous extremity of the hair is enclosed in a membranous sheath and capsule, which is closely connected with the cutis and cellular membrane. Several small filaments pass from the membranous sheath, called its roots; these form a firm attachment for the hair, and probably contain vessels, which furnish the oily secretion of the membrane of the internal tubular cavity.

Anatomists have enumerated other structures connected with the bulb: namely, a second membrane lining the capsule, of a red colour, soft and thin, and said to be a continuation of the rete mucosum: and within the cavity of the bulb, numerous conical papillæ, which are attached to the sides of the cavity at their bases, having their apices free and pointed towards the aperture of the bulb; also sebaceous follicles, nerves and blood-vessels distributed within the bulb. Of my own knowledge, I cannot say that such numerous structures are to be discovered in the human hair; and rather suspect, that these descriptions are taken from the formation of the feathers of birds, or the large feelers or bristles which serve particular purposes in different animals. If you pull out a hair, it generally brings along with it the membranous sheath of its bulb, and the pulpy roots attached: these may be scraped off, when the form of the bulb is apparent, of a white colour, and having a soft filament still adhering at the extremity or entrance to the bulb.

In those animals which have feelers attached near their noses and jaws, the bulbous extremity is enclosed in a tendinous sheath, which is again enveloped in a sheath or capsule of a cartilaginous consistence: these capsules are open at each extremity; externally, to enclose the tube of the feeler; and internally, to admit of the nerves and blood-vessels which are distributed to them. The space between the two capsules is lined with a vascular membrane, giving it a complete red colour, and is filled with a limpid watery fluid; in which, and on the membrane, an abundance of nervous filaments are distributed. In this cavity the bulb of the feeler is moveable; and being confined by the enclosure of cutis immediately above the cartilaginous structure, the motion at the free extremity of the feeler is communicated to the fluid enclosure, and delicate nervous filaments enclosed within it. From the extraordinary size of the nerve, and its termination in a watery medium, it is not improbable that a sense similar to that of hearing may be communicated by this curious structure. The bristles or feelers are erected, turned in various directions, or fixed, by numerous minute muscles attached to the cartilaginous capsule: and it is remarkable, that the minuter hairs around the feelers are arranged diverging from their entrance to the skin, so as not to interfere by contact with the more delicate motions communicated from without.

Great variety is presented in the form and texture of the hairs of different animals, as well as on different parts of the same animal: a similarity of structure, however, probably appertains to all; not only in the different sorts of hair, wool, fur, and bristles of the porcupine, but in the feathers of birds.

It is generally supposed that the hairs, in passing out of the skin, receive a covering from the cuticle, which accompanies them to their pointed extremities: this covering I have not been able to trace, and rather doubt its existence from the following circumstance:—The hair in the progress of its growth, when it has passed through the cutis, is arrested in its passage by the cuticle, and will make several coils and turns underneath it—which it would not do, if its covering was in the nature of a prolongation extending from the cuticle. These may be readily seen on the back of the arm of a hairy person; and on breaking away the superstructure of cuticle, the young hair will spring up, uncoil, and soon assume the direction of the neighbouring hairs. The length of the coiled hair, is from one to two-eighths of an inch. I am equally doubtful of the covering of cutis, said to extend underneath the bulb, by a process passing in an opposite direction to the cuticle. In the larger hairs or bristles, the attachment is only at the anterior surface of the cutis, where the upper portion of the bulb and tubular parts are firmly enclosed.

The hair presents several varieties of texture in the human subject, and is much more abundant in some situations than in others. Its greatest accumulation is upon the head, where it is much longer in the female than in the male; and by its flowing length and graceful curls, forms a principal feature of beauty.

Hair of a stronger texture, and more inclined to short curls, forms the beard, which is found only in the male; while hair of intermediate texture grows in abundance on the pubes, on the scrotum, the labia, in the arm-pits, and, in the male, around the anus; and more abundantly on the front than on the back part of the body, and on the anterior than on the internal parts of the arms, thighs, and legs; on the backs of the hands, and back part of the bodies of the third phalanges of the fingers and toes. There is, however, a great difference in the abundance of hair in separate individuals; while some have the hair so abundant, not only in the above-enumerated situations, but generally over the body, excepting only a small portion of the face, palms of the hands, and soles of the feet; others are as free as the female from such growths. Besides the above situations, short hairs of a peculiar character form the eye-lashes, others the eye-brows; others are situated in the nostrils, and on the inside of the tragus and antitragus of the external ear. There is also a peculiar, fine, colourless, downy hair, which is found on infants at their birth; this generally comes away during the first month, giving place to newly-formed hairs; in others, it remains many months; and, in some instances, does not appear ever to come off. Fine downy hair of this last description, is commonly seen on the arms and necks of young children, and interspersed generally among the other hairs of the body in the adult. When the cuticle comes away from putrefaction, it separates this fine hair with it; while those of larger structure remain in the cutis.

The colour of the hair in the same individual is generally alike, or nearly so, in all the different parts of the body; they are not however developed in all parts at the same time. The colour also varies at different ages.

In the fœtus, the hairs are generally of one size and colour; after birth they grow faster on the head, while in other parts they appear only at the age of puberty. The colour becomes stronger and darker with increasing age; in old age they again turn white, and secrete a colourless oil; their bulbs appear to dry away, and they drop off in abundance: this change, constituting baldness, is often hereditary, and will commence as early as twenty years of age.

The particular use of hair in the animal economy, is not clearly ascertained, particularly in man, where it does not, as in animals, contribute so much to the warmth of the body. It has a particular attraction for moisture, which swells and lengthens it. It is among the most indestructable parts of the body, and powerfully resists putrefaction. Alkalies soften and dissolve it; hence the advantage gained by first softening the beard by the use of soap, in shaving.

The appendages of the skin, the hairs, and nails, although different formations, appear to be modifications of the same substance as the cuticle; on being burnt, they each emit the same odour; the hoofs and horns of animals, the feathers of birds, are alike in this respect, and leave the same residuum of phosphate of lime. Human hair when burnt, leaves the hydro chlorate of soda, the carbonate, sulphate, and phosphate of lime, and a small quantity of oxyde of manganese. In white hair phosphate of magnesia, and in black hair a considerable quantity of silica are found; while in the red and light-coloured hair, sulphur is detected.

It has been conjectured, that the hair is an excretory to the superabundant phosphate of lime in circulation: and to strengthen this conjecture, it has been remarked, that the urine of quadrupeds abounds less in phosphoric salts, than human urine.

The hair is supposed by some to have a power of erection in extreme fear; but this does not appear to depend on any thing beyond the contraction of the occipito frontalis, which draws the scalp and hairs along with it. In quadrupeds, also, the effect appears to be produced by particular muscular action; and not upon a spontaneous motion inherent in the hairs themselves.

Various accounts have been given of the hair of the head turning white in the course of a single night; there has been, no doubt, much exaggeration in the history of these facts; nevertheless, many of them are so well attested, that there can be little doubt that the hair will turn white, more particularly in young people, in the course of a few days; many such instances were witnessed during the French revolution, although we are not able to account for this change.

The hair is said to undergo a morbid change in its secretion, and that in the disease named plica polonica, when cut near to the skin, blood will exude from the cut extremities; this accumulating, the hairs will be all matted together: but it is probable, that the mere filth of the Poles, among whom this disease is most common, is the sole cause, as its cure has been effected, simply by cutting off the hair. Certain fatty tumours have been found to contain hair, mixed with the sebaceous matter; again, they have been found in ovarian cists; in such cases, they are, however, connected with accidental cutaneous formations. After fevers, it will frequently come off in abundance; nevertheless, like cuticle, it will form again readily, particularly in young persons.

Inveterate headaches have been cured by frequent cutting of the hair; which may probably act like a blister, by calling a new action to the part, as the more frequently hair is cut, the faster it will grow.

ANATOMY OF NAILS.

The nails, the next appendage of the skin, are situated on the dorsal surface of the extremities of the fingers and toes. They are of an oblong, or irregular oval form. They appear to be of the same substance as the cuticle, only of a denser structure.

They are formed of thin plates, of a horny consistence, slightly arched or convex exteriorly, and concave internally.

They are divided in three portions, the root, the body, and the free extremity. The root is the thinnest and softest, and amounts to about one-fifth part of the whole nail.

The root commences in a semilunar groove of the cutis, from which it soon emerges, and then adheres to the cutis only on the inner surface of its body. The nail then projects through the cuticle, making an aperture in it corresponding with the two sides, the under portion of the free extremity, and the external portion of the root at the groove of the cutis. The cuticle, as it approaches the root of the nail, makes a duplicature beyond the edge of the groove of the cutis, thus forming a ridge of cuticle which is seen at the base of the nail; it here appears to divide, sending a thin process which spreads, projecting forwards, on the surface of the base of the nail; and another which passes downwards into the groove of the cutis; (*Vide Plate* II. *Fig.* 15. *a.*) at the side of the nail, it curves round from the part included in the groove, continues along its sides, and passes inwards from the tip of the finger, some way under the free extremity of the nail; this structure is seen at *Plate* II. *Fig.* 15. *b.* The firm adhesion of the cuticle to the nail, and the manner in which the nail perforates the cuticle, is easily seen when the nail is separated in maceration. As the nail passes from the groove in the cutis, it becomes thicker, until it emerges from the cutis; after which it continues of nearly a uniform thickness to the extremity. It is firmly attached to the cutis by numerous longitudinal ridges and depressions, which are closely connected with corresponding ridges and depressions in the surface of the cutis; a horizontal section of this connection would present a junction analogous to a suture.

The nail is of a semitransparent colour, and shews the vascular cutis underneath, excepting near its root, where it is opaque, and of a white colour; this white part commences at a point on either side, and becomes broader in the middle; hence it forms a semilunar arch across the root of the nail. Portions of this white structure will occasionally appear in other parts of the nail, and will gradually reach its free extremity, and disappear with the exuberant growth of the nail.

The nails appear about the fifth month in the fœtus, and are but partially developed at birth, when they do not project above their bodies; hence they have no free extremity, which is an admirable provision for the protection of the parietes of the uterus, which would be liable to injury from the motions of the fœtus if its fingers and toes were armed with projecting nails. The cuticle joins the nail at its extremity, and moreover projects with the tips over the nail, so as to form a cushion around it. (*Vide Plate* II. *Fig.* 13. *and* 14.)

The nails have little or no sensibility, and may be cut without communicating pain; their nerves, or secreting vessels, have not been detected. They appear to be secreted from their roots enclosed in a groove of the cutis, from which point they are continually increasing, and if not cut, would extend at their free extremities several inches in length, as has been observed in some Indian devotees.

When separated from accident or disease, a new nail will readily form; but it will not be so thick and strong as the original, will be more susceptible of injury, and will more easily separate again.

The part from which the nail grows has been termed by

Sir Astley Cooper the ungual gland; who remarks, that a notch made in the root or base of the nail, will be three months growing out; from whence we may conclude, that the nails renew themselves about four times in the year. The nails very often grow into the sides of the fingers and toes; but more particularly in the latter, from the increased pressure of tight shoes. In young persons, this may be relieved by scraping the nail thin; cutting a notch in its free extremity, and by placing a small portion of lint under the pressure; where this will not succeed, it is necessary to pass a small pair of scissors under the nail, and detach a slip from one side, which will effect a cure. In elderly people, this would be attended with danger, and must not be attempted, from the languid circulation, and consequent tendency to gangrene in their lower extremities.

The nails occasionally will grow to a certain distance, when ulcerations will form under them; this disease is often difficult to cure, and cannot be effected until the ungual portion of the nail is destroyed,—an operation attended with excessive pain. An application of arsenical ointment placed above and under the nail, is perhaps the best mode of effecting their separation.

END OF VOL. SECOND.

F. Warr lith.

PLATE I.

1.1. Outer margin of the internal ring, formed by the iliac portion of the fascia transversalis.

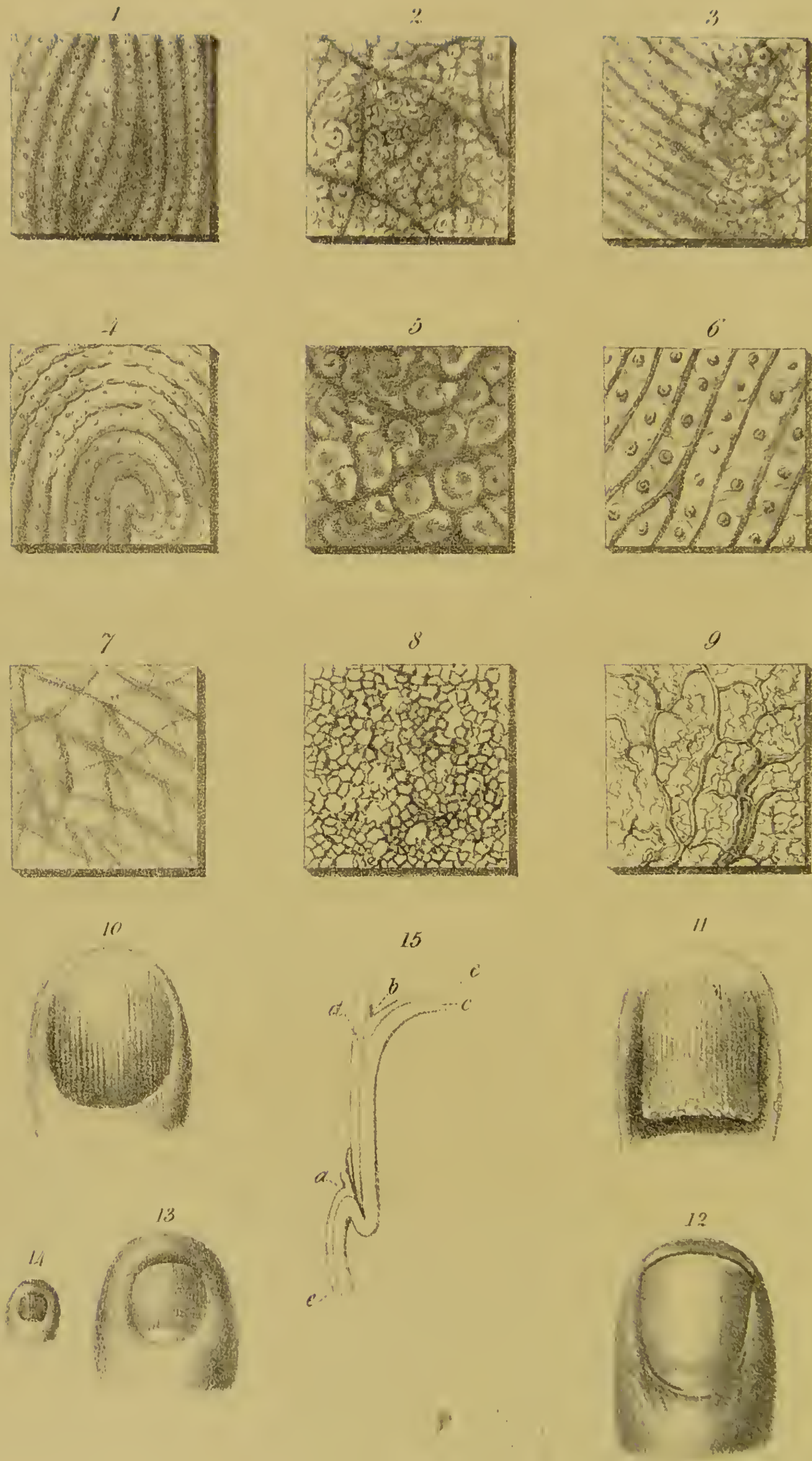
2.2.2.2. Inner margin of the internal ring, formed by the pubic portion of the fascia transversalis.

3. The epigastric artery, seen through the semitransparent pubic portion of the fascia transversalis.

4.4.4. The iliac portion of the fascia lata, forming a crescentic edge about an inch and a half below Poupart's ligament.

5.5.5. The pubic portion of the fascia lata, seen uniting with the iliac portion.

Plate II.



H. J. Shrapnell Fec.t F. Warr lith

PLATE II.

Fig.

1. External view of a portion of cuticle from the palm of the hand, shewing the manner in which the papillæ, or rugæ, are arranged parallel to each other.
2. Surface of the cuticle from the back of the hand, magnified in the proportion of one inch to one eighth of an inch.
3. External view of the cuticle from the side of one of the fingers, shewing the manner in which the arrangement in Fig. 1 and 2 blend into each other.
4. External view of the cuticle from the tip of one of the fingers, shewing minute papillæ between the parallel distributions.
5. Similar view to Fig. 2, magnified with a higher power; the arrangement of the papillæ in this view, is very similar to the structure of the under surface of leaves.
6. Internal surface of the cuticle from the palm of the hand, shewing the openings made through it by the perspiratory pores.
7. View of the external surface of the cutis—magnified as in Fig. 2.
8. The venous distribution of the external surface of the rete mucosum, from a preparation in the Museum at Guy's Hospital—magnified in the same proportion as Fig. 2.
9. The arterial distribution, from a finely injected preparation by Sir Astley Cooper, in the Museum at Guy's Hospital. This arrangement of vessels appears to be underneath the net-work of veins represented in Fig. 8.
10. Surface of the cutis, and the groove which receives the attachment of the nail.
11. The corresponding internal surface of the nail, with the cuticle attached.
12. External view of the nail.
13. Enlarged view of the fœtal nail.
14. Natural size of the fœtal nail.
15. A section to shew the manner in which the cuticle is attached to the nail and cutis, and the commencement of the nail by a thin portion in the groove formed for its reception in the cutis.

    a. Cuticle, forming a duplicature at the root of the nail.
    b. The same in its free continuity.
    c. Cutis.
    d. Nail.
    e. e. Cuticle.

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